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(54) **PORTABLE GAMING DEVICE AND GAMING SYSTEM COMBINING BOTH PHYSICAL AND VIRTUAL PLAY ELEMENTS**

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USPC **345/158**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

973,105	A	10/1910	Chamberlain, Jr.
1,661,058	A	2/1928	Theremin

(Continued)

FOREIGN PATENT DOCUMENTS

CN	1032246	4/1989
CN	1338961	3/2002

(Continued)

OTHER PUBLICATIONS

Acar, et al., "Experimental evaluation and comparative analysis of commercial variable-capacitance MEMS accelerometers," Journal of Micromechanics and Microengineering, vol. 13 (1), pp. 634-645, May 2003.

(Continued)

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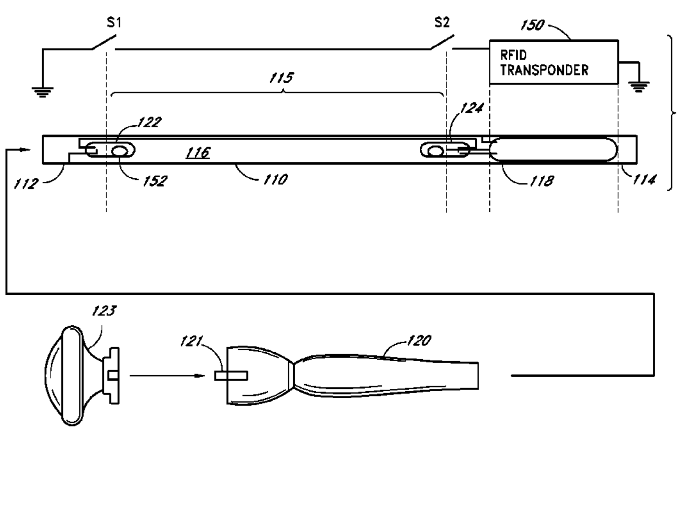
(57) **ABSTRACT**

A wireless input device for playing an interactive motion-sensitive game using a wireless-compatible game console in which a virtual play environment is represented through one or more computer-animated visual, aural or tactile effects is provided wherein game play is conducted by moving, shaking, twisting, waving or pointing the input device in a particular manner. The input device can include motion-sensitive circuitry and/or command circuitry for generating control signals and/or an effects generator and associated control circuitry to enable the input device to selectively generate at least one visual, aural or tactile effect comprising sound, lighting or vibration. The input device can include a wireless transceiver for providing two-way wireless communication with the wireless-compatible game console. An optional display screen displays short text messages received through wireless communications with the wireless-compatible game console.

52 Claims, 47 Drawing Sheets



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(56) **References Cited**

U.S. PATENT DOCUMENTS

1,789,680 A 1/1931 Gwinnett
2,001,366 A 5/1935 Mittelman
2,752,725 A 7/1956 Unsworth
2,902,023 A 9/1959 Waller
3,135,512 A 6/1964 Taylor
3,336,030 A 8/1967 Martell et al.
3,395,920 A 8/1968 Moe
3,454,920 A 7/1969 Mehr
3,456,134 A 7/1969 Ko
3,468,533 A 9/1969 House, Jr.
3,474,241 A 10/1969 Kuipers
D220,268 S 3/1971 Kliewer
3,572,712 A 3/1971 Vick
3,633,904 A 1/1972 Kojima
3,660,648 A 5/1972 Kuipers
3,707,055 A 12/1972 Pearce
3,795,805 A 3/1974 Swanberg et al.
3,843,127 A 10/1974 Lack
3,949,364 A 4/1976 Clark et al.
3,949,679 A 4/1976 Barber
3,973,257 A 8/1976 Rowe
3,978,481 A 8/1976 Angwin et al.
3,997,156 A 12/1976 Barlow et al.
4,009,619 A 3/1977 Snymann
4,038,876 A 8/1977 Morris
4,055,341 A 10/1977 Martinez
4,063,111 A 12/1977 Dobler et al.
4,153,250 A 5/1979 Anthony
4,166,406 A 9/1979 Maughmer
4,171,737 A 10/1979 McLaughlin
4,175,665 A 11/1979 Dogliotti
4,205,785 A 6/1980 Stanley
4,231,077 A 10/1980 Joyce et al.
4,240,638 A 12/1980 Morrison et al.
4,282,681 A 8/1981 McCaslin
4,287,765 A 9/1981 Kreft
4,296,929 A 10/1981 Meyer et al.
4,303,978 A 12/1981 Shaw
4,318,245 A 3/1982 Stowell et al.
4,321,678 A 3/1982 Krogmann
4,325,199 A 4/1982 McEdwards
4,337,948 A 7/1982 Breslow
4,342,985 A 8/1982 Desjardins
4,402,250 A 9/1983 Baasch
4,412,205 A 10/1983 Von Kemenczky
4,425,488 A 1/1984 Moskin
4,443,866 A 4/1984 Burgiss
4,450,325 A 5/1984 Luque
4,503,299 A 3/1985 Henrard
4,514,600 A 4/1985 Lentz
4,514,798 A 4/1985 Lesche
4,540,176 A 9/1985 Baer
4,546,551 A 10/1985 Franks
4,558,604 A 12/1985 Auer
4,561,299 A 12/1985 Orlando
4,575,621 A 3/1986 Dreifus
4,578,674 A 3/1986 Baker et al.
4,595,369 A 6/1986 Downs
4,623,887 A 11/1986 Welles
4,623,930 A 11/1986 Oshima
4,627,620 A 12/1986 Yang
4,645,458 A 2/1987 Williams
4,672,374 A 6/1987 Desjardins
4,678,450 A 7/1987 Scolari et al.
4,695,058 A 9/1987 Carter, III et al.
4,695,953 A 9/1987 Blair et al.
4,699,379 A 10/1987 Chateau et al.
4,739,128 A 4/1988 Grisham
4,750,733 A 6/1988 Foth
4,761,540 A 8/1988 McGeorge
4,776,253 A 10/1988 Downes
4,787,051 A 11/1988 Olson
4,816,810 A 3/1989 Moore
4,817,950 A 4/1989 Goo
4,819,182 A 4/1989 King et al.
4,839,838 A 6/1989 LaBiche et al.
4,843,568 A 6/1989 Krueger et al.
4,849,655 A 7/1989 Bennett
4,851,685 A 7/1989 Dubgen
4,858,390 A 8/1989 Kenig
4,858,930 A 8/1989 Sato
4,862,165 A 8/1989 Gart
4,882,717 A 11/1989 Hayakawa et al.
4,891,032 A 1/1990 Davis
4,904,222 A 2/1990 Gastgeb et al.
4,910,677 A 3/1990 Remedio et al.
4,914,598 A 4/1990 Krogmann
4,918,293 A 4/1990 McGeorge
4,924,358 A 5/1990 VonHeck
4,932,917 A 6/1990 Klitsner
4,957,291 A 9/1990 Miffitt
4,960,275 A 10/1990 Magon
4,961,369 A 10/1990 McGill
4,964,837 A 10/1990 Collier
4,967,321 A 10/1990 Cimock
4,969,647 A 11/1990 Mical et al.
4,980,519 A 12/1990 Mathews
4,988,981 A 1/1991 Zimmerman et al.
4,994,795 A 2/1991 MacKenzie
5,011,161 A 4/1991 Galphin
5,036,442 A 7/1991 Brown
RE33,662 E 8/1991 Blair et al.
5,045,843 A 9/1991 Hansen
5,048,831 A 9/1991 Sides
D320,624 S 10/1991 Taylor
5,058,480 A 10/1991 Suzuki et al.
5,059,958 A 10/1991 Jacobs et al.
5,062,696 A 11/1991 Oshima
5,068,645 A 11/1991 Drumm
D322,242 S 12/1991 Cordell
5,076,584 A 12/1991 Openiano
D325,225 S 4/1992 Adhida
5,114,155 A 5/1992 Tillery et al.
5,114,344 A 5/1992 Fumagalli et al.
5,124,938 A 6/1992 Algrain
5,127,657 A 7/1992 Ikezawa et al.
5,128,671 A 7/1992 Thomas, Jr.
D328,463 S 8/1992 King et al.
5,136,222 A 8/1992 Yamamoto
5,138,154 A 8/1992 Hotelling
5,145,446 A 9/1992 Kuo
D331,058 S 11/1992 Morales
5,166,502 A 11/1992 Rendleman
5,170,002 A 12/1992 Suzuki et al.
5,175,481 A 12/1992 Kanno
5,177,311 A 1/1993 Suzuki et al.
5,178,477 A 1/1993 Gambaro
5,181,181 A 1/1993 Glynn
5,184,830 A 2/1993 Okada et al.
5,188,368 A 2/1993 Ryan
5,190,285 A 3/1993 Levy et al.
5,192,082 A 3/1993 Inoue et al.
5,192,823 A 3/1993 Suzuki et al.
5,194,006 A 3/1993 Zaenglein, Jr.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,194,048	A	3/1993	Briggs
5,202,844	A	4/1993	Kamio
5,207,426	A	5/1993	Inoue et al.
5,212,368	A	5/1993	Hara
5,213,327	A	5/1993	Kitaue
5,223,698	A	6/1993	Kapur
5,231,568	A	7/1993	Cohen et al.
D338,242	S	8/1993	Cordell
5,232,223	A	8/1993	Dornbusch
5,236,200	A	8/1993	McGregor et al.
5,247,651	A	9/1993	Clarisse
D340,042	S	10/1993	Copper et al.
5,259,626	A	11/1993	Ho
5,262,777	A	11/1993	Low et al.
D342,256	S	12/1993	Payne et al.
5,277,645	A	1/1994	Kelley et al.
5,279,513	A	1/1994	Connelly
5,280,744	A	1/1994	DeCarlo et al.
D345,164	S	3/1994	Grae
5,290,964	A	3/1994	Hiyoshi et al.
5,292,124	A	3/1994	Carpenter
5,292,254	A	3/1994	Miller et al.
5,296,871	A	3/1994	Paley
5,299,967	A	4/1994	Gilbert
5,307,325	A	4/1994	Scheiber
5,310,192	A	5/1994	Miyake
5,317,394	A	5/1994	Hale
5,319,548	A	6/1994	Germain
5,320,358	A	6/1994	Jones
5,320,362	A	6/1994	Bear et al.
5,329,276	A	7/1994	Hirabayashi
5,332,322	A	7/1994	Gambaro
5,339,095	A	8/1994	Redford
D350,736	S	9/1994	Takahashi et al.
D350,782	S	9/1994	Barr
D351,430	S	10/1994	Barr
5,354,057	A	10/1994	Pruitt et al.
5,356,343	A	10/1994	Lovetere
5,357,267	A	10/1994	Inoue
5,359,321	A	10/1994	Ribic
5,359,348	A	10/1994	Pilcher et al.
5,363,120	A	11/1994	Drumm
5,365,214	A	11/1994	Angott et al.
5,366,229	A	11/1994	Suzuki
5,369,580	A	11/1994	Monji
5,369,889	A	12/1994	Callaghan
5,372,365	A	12/1994	McTeigue et al.
5,373,857	A	12/1994	Travers et al.
5,378,197	A	1/1995	Briggs
5,382,026	A	1/1995	Harvard et al.
5,393,074	A	2/1995	Bear et al.
5,396,227	A	3/1995	Carroll et al.
5,396,265	A	3/1995	Ulrich et al.
5,403,238	A	4/1995	Baxter et al.
5,405,294	A	4/1995	Briggs
5,411,269	A	5/1995	Thomas
5,416,535	A	5/1995	Sato et al.
5,421,590	A	6/1995	Robbins
5,422,956	A	6/1995	Wheaton
5,429,361	A	7/1995	Raven et al.
5,430,435	A	7/1995	Hoch et al.
5,432,864	A	7/1995	Lu et al.
5,435,561	A	7/1995	Conley
5,435,569	A	7/1995	Zilliox
D360,903	S	8/1995	Barr et al.
5,439,199	A	8/1995	Briggs et al.
5,440,326	A	8/1995	Quinn
5,443,261	A	8/1995	Lee et al.
5,452,893	A	9/1995	Faulk et al.
5,453,053	A	9/1995	Danta et al.
5,453,758	A	9/1995	Sato
D362,870	S	10/1995	Oikawa
5,459,489	A	10/1995	Redford
5,469,194	A	11/1995	Clark et al.
5,481,957	A	1/1996	Paley
5,482,510	A	1/1996	Ishii et al.
5,484,355	A	1/1996	King
5,485,171	A	1/1996	Copper et al.
5,488,362	A	1/1996	Ullman et al.
5,490,058	A	2/1996	Yamasaki
5,498,002	A	3/1996	Gechter
5,502,486	A	3/1996	Ueda
5,506,605	A	4/1996	Paley
5,509,806	A	4/1996	Ellsworth
5,512,892	A	4/1996	Corballis et al.
5,516,105	A	5/1996	Eisenbrey et al.
5,517,183	A	5/1996	Bozeman
5,523,800	A	6/1996	Dudek
5,524,637	A	6/1996	Erickson
5,526,022	A	6/1996	Donahue et al.
5,528,265	A	6/1996	Harrison
5,531,443	A	7/1996	Cruz
5,533,933	A	7/1996	Garnjost et al.
5,541,860	A	7/1996	Takei et al.
5,550,721	A	8/1996	Rapisarda
5,551,701	A	9/1996	Bouton et al.
5,554,033	A	9/1996	Bizzi et al.
5,554,980	A	9/1996	Hashimoto et al.
5,561,543	A	10/1996	Ogawa
5,563,628	A	10/1996	Stroop
5,569,085	A	10/1996	Igarashi et al.
D375,326	S	11/1996	Yokoi et al.
5,573,011	A	11/1996	Felsing
5,574,479	A	11/1996	Odell
5,579,025	A	11/1996	Itoh
D376,826	S	12/1996	Ashida
5,580,319	A	12/1996	Hamilton
5,581,484	A	12/1996	Prince
5,585,584	A	12/1996	Usa
5,586,767	A	12/1996	Bohland
5,587,558	A	12/1996	Matsushima
5,587,740	A	12/1996	Brennan
5,594,465	A	1/1997	Poulachon
5,598,187	A	1/1997	Ide et al.
5,602,569	A	2/1997	Kato
5,603,658	A	2/1997	Cohen
5,605,505	A	2/1997	Han
5,606,343	A	2/1997	Tsuboyama
5,611,731	A	3/1997	Bouton et al.
5,613,913	A	3/1997	Ikematsu et al.
5,615,132	A	3/1997	Horton
5,621,459	A	4/1997	Ueda
5,623,581	A	4/1997	Attenberg
5,624,117	A	4/1997	Ohkubo et al.
5,627,565	A	5/1997	Morishita et al.
5,632,878	A	5/1997	Kitano
D379,832	S	6/1997	Ashida
5,640,152	A	6/1997	Copper
5,641,288	A	6/1997	Zaenglein, Jr.
5,642,931	A	7/1997	Gappelberg
5,643,087	A	7/1997	Marcus et al.
5,645,077	A	7/1997	Foxlin
5,645,277	A	7/1997	Cheng
5,647,796	A	7/1997	Cohen
5,649,867	A	7/1997	Briggs
5,651,049	A	7/1997	Easterling et al.
5,655,053	A	8/1997	Renie
5,662,332	A	9/1997	Garfield
5,662,525	A	9/1997	Briggs
5,666,138	A	9/1997	Culver
5,667,217	A	9/1997	Kelly et al.
5,667,220	A	9/1997	Cheng
5,670,845	A	9/1997	Grant
5,670,988	A	9/1997	Tickle
5,672,090	A	9/1997	Liu
5,674,128	A	10/1997	Holch et al.
5,676,450	A	10/1997	Sink et al.
5,676,673	A	10/1997	Ferre et al.
5,679,004	A	10/1997	McGowan et al.
5,682,181	A	10/1997	Nguyen et al.
5,685,776	A	11/1997	Stambolic et al.
5,685,778	A	11/1997	Sheldon et al.
5,694,340	A	12/1997	Kim
5,698,784	A	12/1997	Hotelling et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,701,131	A	12/1997	Kuga
5,702,232	A	12/1997	Moore
5,702,305	A	12/1997	Norman et al.
5,702,323	A	12/1997	Poulton
5,703,623	A	12/1997	Hall et al.
5,716,216	A	2/1998	O'Loughlin et al.
5,716,281	A	2/1998	Dote
5,724,106	A	3/1998	Autry et al.
5,724,497	A	3/1998	San et al.
5,726,675	A	3/1998	Inoue
5,733,131	A	3/1998	Park
5,734,371	A	3/1998	Kaplan
5,734,373	A	3/1998	Rosenberg
5,734,807	A	3/1998	Sumi
D393,884	S	4/1998	Hayami
5,736,970	A	4/1998	Bozeman
5,739,811	A	4/1998	Rosenberg et al.
5,741,182	A	4/1998	Lipps et al.
5,741,189	A	4/1998	Briggs
5,742,331	A	4/1998	Uomori
5,745,226	A	4/1998	Gigioli
D394,264	S	5/1998	Sakamoto et al.
5,746,602	A	5/1998	Kikinis
5,751,273	A	5/1998	Cohen
5,752,880	A	5/1998	Gabai et al.
5,752,882	A	5/1998	Acres et al.
5,757,305	A	5/1998	Xydis
5,757,354	A	5/1998	Kawamura
5,757,360	A	5/1998	Nitta et al.
D395,464	S	6/1998	Shiibashi et al.
5,764,224	A	6/1998	Lilja et al.
5,769,719	A	6/1998	Hsu
5,770,533	A	6/1998	Franchi
5,771,038	A	6/1998	Wang
5,772,508	A	6/1998	Sugita et al.
D396,468	S	7/1998	Schindler et al.
5,775,998	A	7/1998	Ikematsu et al.
5,779,240	A	7/1998	Santella
5,785,317	A	7/1998	Sasaki
5,785,592	A	7/1998	Jacobsen
5,786,626	A	7/1998	Brady et al.
D397,162	S	8/1998	Yokoi et al.
5,791,648	A	8/1998	Hohl
5,794,081	A	8/1998	Itoh
5,796,354	A	8/1998	Cartabiano et al.
5,803,740	A	9/1998	Gesink et al.
5,803,840	A	9/1998	Young
5,806,849	A	9/1998	Rutkowski
5,807,284	A	9/1998	Foxlin
5,810,666	A	9/1998	Mero et al.
5,811,896	A	9/1998	Grad
5,819,206	A	10/1998	Horton et al.
5,820,462	A	10/1998	Yokoi et al.
5,820,471	A	10/1998	Briggs
5,820,472	A	10/1998	Briggs
5,822,713	A	10/1998	Profeta
5,825,298	A	10/1998	Walter
5,825,350	A	10/1998	Case, Jr. et al.
D400,885	S	11/1998	Goto
5,830,065	A	11/1998	Sitrick
5,831,553	A	11/1998	Lenssen et al.
5,833,549	A	11/1998	Zur et al.
5,835,077	A	11/1998	Dao et al.
5,835,156	A	11/1998	Blonstein et al.
5,835,576	A	11/1998	Katz
5,836,817	A	11/1998	Acres et al.
5,838,138	A	11/1998	Henty
5,841,409	A	11/1998	Ishibashi et al.
D402,328	S	12/1998	Ashida
5,847,854	A	12/1998	Benson, Jr.
5,850,624	A	12/1998	Gard
5,851,149	A	12/1998	Xidos et al.
5,853,327	A	12/1998	Gilboa
5,853,332	A	12/1998	Briggs
5,854,622	A	12/1998	Brannon
5,855,483	A	1/1999	Collins et al.
D405,071	S	2/1999	Gambaro
5,865,680	A	2/1999	Briggs
5,867,146	A	2/1999	Kim et al.
5,874,941	A	2/1999	Yamada
5,875,257	A	2/1999	Marrin et al.
D407,071	S	3/1999	Keating
D407,761	S	4/1999	Barr
5,893,562	A	4/1999	Spector
5,897,437	A	4/1999	Nishiumi
5,898,421	A	4/1999	Quinn
5,900,867	A	5/1999	Schindler et al.
5,901,246	A	5/1999	Hoffberg et al.
5,902,968	A	5/1999	Sato et al.
5,906,542	A	5/1999	Neumann
D410,909	S	6/1999	Tickle
5,908,996	A	6/1999	Litterst et al.
5,911,634	A	6/1999	Nidata et al.
5,912,612	A	6/1999	DeVolpi
5,913,019	A	6/1999	Attenberg
5,913,727	A	6/1999	Ahdoot
5,919,149	A	7/1999	Allum
5,923,317	A	7/1999	Sayler et al.
5,924,695	A	7/1999	Heykoop
5,926,780	A	7/1999	Fox et al.
5,929,782	A	7/1999	Stark et al.
5,929,841	A	7/1999	Fujii
5,929,848	A	7/1999	Albukerk et al.
D412,940	S	8/1999	Kato et al.
5,931,739	A	8/1999	Layer et al.
5,942,969	A	8/1999	Wicks
5,944,533	A	8/1999	Wood
5,946,444	A	8/1999	Evans et al.
5,947,789	A	9/1999	Chan
5,947,868	A	9/1999	Dugan
5,955,713	A	9/1999	Titus
5,955,988	A	9/1999	Blonstein
5,956,035	A	9/1999	Sciammarella
5,957,779	A	9/1999	Larson
5,961,386	A	10/1999	Sawaguchi
5,963,136	A	10/1999	O'Brien
5,964,660	A	10/1999	James et al.
5,967,898	A	10/1999	Takasaka et al.
5,967,901	A	10/1999	Briggs
5,971,270	A	10/1999	Barna
5,971,271	A	10/1999	Wynn et al.
5,973,757	A	10/1999	Aubuchon et al.
5,980,254	A	11/1999	Muehle et al.
5,982,352	A	11/1999	Pryor
5,982,356	A	11/1999	Akiyama
5,984,785	A	11/1999	Takeda et al.
5,984,788	A	11/1999	Lebensfeld et al.
5,986,570	A	11/1999	Black et al.
5,986,644	A	11/1999	Herder
5,989,120	A	11/1999	Truchsess
5,991,085	A	11/1999	Rallison et al.
5,991,693	A	11/1999	Zalewski
5,996,033	A	11/1999	Chiu-Hao
5,999,168	A	12/1999	Rosenberg
6,001,014	A	12/1999	Ogata
6,001,015	A	12/1999	Nishiumi et al.
6,002,394	A	12/1999	Schein
6,009,458	A	12/1999	Hawkins et al.
D419,199	S	1/2000	Cordell et al.
D419,200	S	1/2000	Ashida
6,010,406	A	1/2000	Kajikawa et al.
6,011,526	A	1/2000	Toyoshima et al.
6,012,980	A	1/2000	Yoshida et al.
6,012,984	A	1/2000	Roseman
6,013,007	A	1/2000	Root et al.
6,016,144	A	1/2000	Blonstein
6,019,680	A	2/2000	Cheng
6,020,876	A	2/2000	Rosenberg
6,024,647	A	2/2000	Bennett et al.
6,024,675	A	2/2000	Kashiwaguchi
6,025,830	A	2/2000	Cohen
6,037,882	A	3/2000	Levy
6,044,297	A	3/2000	Sheldon
6,049,823	A	4/2000	Hwang

(56) References Cited

U.S. PATENT DOCUMENTS

6,052,083	A	4/2000	Wilson
6,057,788	A	5/2000	Cummings
6,058,342	A	5/2000	Orbach
6,059,576	A	5/2000	Brann
6,060,847	A	5/2000	Hettema et al.
6,066,075	A	5/2000	Poulton
6,069,594	A	5/2000	Barnes et al.
6,072,467	A	6/2000	Walker
6,072,470	A	6/2000	Ishigaki
6,075,443	A	6/2000	Schepps et al.
6,075,575	A	6/2000	Schein et al.
6,076,734	A	6/2000	Dougherty et al.
6,077,106	A	6/2000	Mish
6,078,789	A	6/2000	Bodenmann
6,079,982	A	6/2000	Meader
6,080,063	A	6/2000	Khosla
6,081,819	A	6/2000	Ogino
6,084,315	A	7/2000	Schmitt
6,084,577	A	7/2000	Sato et al.
6,085,805	A	7/2000	Bates
6,087,950	A	7/2000	Capan
6,089,987	A	7/2000	Briggs
6,091,342	A	7/2000	Janesch et al.
D429,718	S	8/2000	Rudolph
6,095,926	A	8/2000	Hettema et al.
6,102,406	A	8/2000	Miles et al.
6,110,039	A	8/2000	Oh
6,110,041	A	8/2000	Walker et al.
6,115,028	A	9/2000	Balakrishnan
6,127,990	A	10/2000	Zwern
6,129,549	A	10/2000	Thompson
6,132,318	A	10/2000	Briggs
6,137,457	A	10/2000	Tokuhashi
D433,381	S	11/2000	Talesfore
6,142,870	A	11/2000	Wada
6,142,876	A	11/2000	Cumbers
6,144,367	A	11/2000	Berstis
6,146,278	A	11/2000	Kobayashi
6,148,100	A	11/2000	Anderson et al.
6,149,490	A	11/2000	Hampton
6,150,947	A	11/2000	Shima
6,154,723	A	11/2000	Cox et al.
6,155,926	A	12/2000	Miyamoto et al.
6,160,405	A	12/2000	Needle
6,160,540	A	12/2000	Fishkin et al.
6,160,986	A	12/2000	Gabai et al.
6,162,122	A	12/2000	Acres et al.
6,162,123	A	12/2000	Woolston
6,162,191	A	12/2000	Foxlin
6,164,808	A	12/2000	Shibata
6,171,190	B1	1/2001	Thanasack et al.
6,174,242	B1	1/2001	Briggs et al.
6,176,837	B1	1/2001	Foxlin
6,181,253	B1	1/2001	Eschenbach et al.
6,181,329	B1	1/2001	Stork et al.
6,183,364	B1	2/2001	Trovato
6,183,365	B1	2/2001	Tonomura et al.
6,184,847	B1	2/2001	Fateh et al.
6,184,862	B1	2/2001	Leiper
6,184,863	B1	2/2001	Sibert
6,186,902	B1	2/2001	Briggs
6,191,774	B1	2/2001	Schena
6,196,893	B1	3/2001	Casola et al.
6,198,295	B1	3/2001	Hill
6,198,470	B1	3/2001	Agam et al.
6,198,471	B1	3/2001	Cook
6,200,216	B1	3/2001	Peppel
6,200,219	B1	3/2001	Rudell et al.
6,200,253	B1	3/2001	Nishiumi
6,201,554	B1	3/2001	Lands
6,206,745	B1	3/2001	Gabai et al.
6,206,782	B1	3/2001	Walker et al.
6,210,287	B1	4/2001	Briggs
6,211,861	B1	4/2001	Rosenberg et al.
6,214,155	B1	4/2001	Leighton
6,217,450	B1	4/2001	Meredith
6,217,478	B1	4/2001	Vohmann
6,220,171	B1	4/2001	Hettema et al.
6,220,964	B1	4/2001	Miyamoto
6,220,965	B1	4/2001	Hanna et al.
6,222,522	B1	4/2001	Mathews
D442,998	S	5/2001	Ashida
6,224,486	B1	5/2001	Walker et al.
6,224,491	B1	5/2001	Hiromi et al.
6,225,987	B1	5/2001	Matsuda
6,226,534	B1	5/2001	Aizawa
6,227,966	B1	5/2001	Yokoi
6,227,974	B1	5/2001	Eilat et al.
6,231,451	B1	5/2001	Briggs
6,234,803	B1	5/2001	Watkins
6,238,289	B1	5/2001	Sobota et al.
6,238,291	B1	5/2001	Fujimoto et al.
6,239,806	B1	5/2001	Nishiumi et al.
RE37,220	E	6/2001	Rapisarda et al.
6,241,611	B1	6/2001	Takeda et al.
6,243,491	B1	6/2001	Andersson
6,243,658	B1	6/2001	Raby
6,244,987	B1	6/2001	Ohsuga et al.
6,245,014	B1	6/2001	Brainard et al.
6,248,019	B1	6/2001	Mudie et al.
6,254,101	B1	7/2001	Young
6,254,394	B1	7/2001	Draper et al.
6,261,180	B1	7/2001	Lebensfeld et al.
6,264,202	B1	7/2001	Briggs
6,264,558	B1	7/2001	Nishiumi et al.
6,265,984	B1	7/2001	Molinaroli
6,267,673	B1	7/2001	Miyamoto et al.
6,273,425	B1	8/2001	Westfall et al.
6,273,819	B1	8/2001	Strauss et al.
6,280,327	B1	8/2001	Leifer et al.
6,280,328	B1	8/2001	Holch et al.
6,283,862	B1	9/2001	Richter
6,283,871	B1	9/2001	Briggs
6,287,200	B1	9/2001	Sharma
6,290,565	B1	9/2001	Galyean, III et al.
6,290,566	B1	9/2001	Gabai et al.
6,293,684	B1	9/2001	Riblett
6,297,751	B1	10/2001	Fadavi-Ardekani
6,301,534	B1	10/2001	McDermott
6,302,793	B1	10/2001	Fertitta, III et al.
6,302,796	B1	10/2001	Lebensfeld et al.
6,304,250	B1	10/2001	Yang
6,311,982	B1	11/2001	Lebensfeld et al.
6,315,673	B1	11/2001	Kopera
6,320,495	B1	11/2001	Sporgis
6,322,365	B1	11/2001	Shechter et al.
6,323,614	B1	11/2001	Palaxxolo
6,323,654	B1	11/2001	Needle
6,325,718	B1	12/2001	Nishiumi et al.
6,328,648	B1	12/2001	Walker et al.
6,328,650	B1	12/2001	Fukawa et al.
6,329,648	B1	12/2001	Delatorre
6,330,427	B1	12/2001	Tabachnik
6,331,841	B1	12/2001	Tokuhashi
6,331,856	B1	12/2001	VanHook
6,332,840	B1	12/2001	Nishiumi et al.
6,337,954	B1	1/2002	Soshi
6,342,010	B1	1/2002	Slifer
6,346,047	B1	2/2002	Sobota
6,347,993	B1	2/2002	Kondo et al.
6,347,998	B1	2/2002	Yoshitomi et al.
6,350,199	B1	2/2002	Williams et al.
6,352,478	B1	3/2002	Gabai et al.
6,356,867	B1	3/2002	Gabai et al.
6,361,396	B1	3/2002	Snyder
6,361,507	B1	3/2002	Foxlin
D456,410	S	4/2002	Ashida
6,364,735	B1	4/2002	Bristow et al.
6,368,177	B1	4/2002	Gabai et al.
6,368,217	B2	4/2002	Kanno
6,369,794	B1	4/2002	Sakurai et al.
6,369,908	B1	4/2002	Frey et al.
6,371,375	B1	4/2002	Ackley et al.
6,371,853	B1	4/2002	Borta

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,375,566 B1 4/2002 Yamada
6,375,569 B1 4/2002 Acres
6,375,572 B1 4/2002 Masuyama et al.
6,375,578 B1 4/2002 Briggs
6,377,793 B1 4/2002 Jenkins
6,377,906 B1 4/2002 Rowe
D456,854 S 5/2002 Ashida
6,383,079 B1 5/2002 Takeda et al.
6,386,538 B1 5/2002 Mejia
6,392,613 B1 5/2002 Goto
6,394,904 B1 5/2002 Stalker
6,400,480 B1 6/2002 Thomas
6,400,996 B1 6/2002 Hoffberg et al.
6,404,409 B1 6/2002 Solomon
6,409,379 B1 6/2002 Gabathuler et al.
6,409,604 B1 6/2002 Matsuno
6,409,687 B1 6/2002 Foxlin
D459,727 S 7/2002 Ashida
D460,787 S 7/2002 Nishikawa
6,414,589 B1 7/2002 Angott et al.
6,415,223 B1 7/2002 Lin
6,421,056 B1 7/2002 Nishiumi
6,424,333 B1 7/2002 Tremblay
6,426,719 B1 7/2002 Nagareda
6,426,741 B1 7/2002 Goldsmith et al.
6,438,193 B1 8/2002 Ko
D462,683 S 9/2002 Ashida
6,445,960 B1 9/2002 Borta
6,452,494 B1 9/2002 Harrison
6,456,276 B1 9/2002 Park
D464,052 S 10/2002 Fletcher
D464,950 S 10/2002 Fraquelli et al.
6,462,769 B1 10/2002 Trowbridge et al.
6,463,257 B1 10/2002 Wood
6,463,859 B1 10/2002 Ikezawa
6,466,198 B1 10/2002 Feinstein
6,466,831 B1 10/2002 Shibata
6,473,070 B2 10/2002 Mishra et al.
6,473,713 B1 10/2002 McCall
6,474,159 B1 11/2002 Foxlin et al.
6,482,067 B1 11/2002 Pickens
6,484,080 B2 11/2002 Breed
6,490,409 B1 12/2002 Walker
6,492,981 B1 12/2002 Stork et al.
6,494,457 B2 12/2002 Conte et al.
6,496,122 B2 12/2002 Sampsell
6,509,217 B1 1/2003 Reddy
6,512,511 B2 1/2003 Willner
6,517,438 B2 2/2003 Tosaki
6,518,952 B1 2/2003 Leiper
6,525,660 B1 2/2003 Surintrspanont
6,526,158 B1 2/2003 Goldberg
6,527,638 B1 3/2003 Walker et al.
6,527,646 B1 3/2003 Briggs
6,530,838 B2 3/2003 Ha et al.
6,530,841 B2 3/2003 Bull et al.
6,538,675 B2 3/2003 Aratani
D473,942 S 4/2003 Motoki et al.
6,540,607 B2 4/2003 Mokris et al.
6,540,611 B1 4/2003 Nagata
6,544,124 B2 4/2003 Ireland
6,544,126 B2 4/2003 Sawano
6,545,611 B2 4/2003 Hayashi et al.
6,545,661 B1 * 4/2003 Goschy et al. 345/158
6,551,165 B2 4/2003 Smirnov
6,551,188 B2 4/2003 Toyama et al.
6,554,707 B1 4/2003 Sinclair et al.
6,554,781 B1 4/2003 Carter et al.
D474,763 S 5/2003 Tozaki et al.
6,558,225 B1 5/2003 Rehkemper et al.
6,560,511 B1 5/2003 Yokoo et al.
6,561,049 B2 5/2003 Akiyama et al.
6,565,438 B2 5/2003 Ogino
6,565,444 B2 5/2003 Nagata et al.
6,567,536 B2 5/2003 McNitt et al.
6,569,023 B1 5/2003 Briggs
6,572,108 B1 6/2003 Bristow
6,575,753 B2 6/2003 Rosa et al.
6,577,350 B1 6/2003 Proehl
6,579,098 B2 6/2003 Shechter
6,582,299 B1 6/2003 Matsuyama et al.
6,582,380 B2 6/2003 Kazlausky et al.
6,583,783 B1 6/2003 Dietrich
6,585,596 B1 7/2003 Leifer et al.
6,589,120 B1 7/2003 Takahashi
6,590,536 B1 7/2003 Walton
6,591,677 B2 7/2003 Rothoff
6,592,461 B1 7/2003 Raviv et al.
6,595,863 B2 7/2003 Chamberlain et al.
6,597,342 B1 7/2003 Haruta
6,597,443 B2 7/2003 Boman
6,598,978 B2 7/2003 Hasegawa
6,599,194 B1 7/2003 Smith
6,605,038 B1 8/2003 Teller et al.
6,607,123 B1 8/2003 Jollifee et al.
6,608,563 B2 8/2003 Weston et al.
6,609,969 B1 8/2003 Luciano et al.
6,609,977 B1 8/2003 Shimizu
6,616,452 B2 9/2003 Clark et al.
6,616,535 B1 9/2003 Nishizak
6,616,607 B2 9/2003 Hashimoto
6,626,728 B2 9/2003 Holt
6,628,257 B1 9/2003 Oka
6,629,019 B2 9/2003 Legge et al.
6,632,142 B2 10/2003 Keith
6,633,155 B1 10/2003 Liang
6,634,949 B1 10/2003 Briggs et al.
6,636,826 B1 10/2003 Abe et al.
6,641,482 B2 11/2003 Masuyama et al.
6,642,837 B1 11/2003 Vigoda et al.
6,650,029 B1 11/2003 Johnston
6,650,313 B2 11/2003 Levine
6,650,345 B1 11/2003 Saito
6,651,268 B1 11/2003 Briggs
6,654,001 B1 11/2003 Su
6,672,962 B1 1/2004 Ozaki et al.
6,676,520 B2 1/2004 Nishiumi et al.
6,676,524 B1 1/2004 Botzas
6,677,990 B1 1/2004 Kawahara
6,681,629 B2 1/2004 Foxlin et al.
6,682,074 B2 1/2004 Weston
6,682,351 B1 1/2004 Abraham-Fuchs et al.
6,684,062 B1 1/2004 Gosior et al.
D486,145 S 2/2004 Kaminski et al.
6,686,954 B1 2/2004 Kitaguchi
6,692,170 B2 2/2004 Abir
6,693,622 B1 2/2004 Shahoian et al.
6,702,672 B1 3/2004 Angell et al.
6,709,336 B2 3/2004 Siegel et al.
6,712,692 B2 3/2004 Basson
6,716,102 B2 4/2004 Whitten et al.
6,717,573 B1 4/2004 Shahoian et al.
6,717,673 B1 4/2004 Janssen
6,718,280 B2 4/2004 Hermann
6,725,107 B2 4/2004 MacPherson
6,725,173 B2 4/2004 An
6,726,099 B2 4/2004 Becker et al.
D489,361 S 5/2004 Mori et al.
6,729,934 B1 5/2004 Driscoll et al.
6,733,390 B2 5/2004 Walker et al.
6,736,009 B1 5/2004 Schwabe
6,739,874 B2 5/2004 Marcus et al.
6,739,979 B2 5/2004 Tracy
D491,924 S 6/2004 Kaminski et al.
D492,285 S 6/2004 Ombao et al.
6,743,104 B1 6/2004 Ota et al.
6,746,334 B1 6/2004 Barney
6,747,632 B2 6/2004 Howard
6,747,690 B2 6/2004 Molgaard
6,749,432 B2 6/2004 French et al.
6,752,719 B2 6/2004 Himoto et al.
6,753,849 B1 6/2004 Curran et al.
6,753,888 B2 6/2004 Kamiwada
6,757,068 B2 6/2004 Foxlin

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,757,446	B1	6/2004	Li
6,761,637	B2	7/2004	Weston et al.
6,765,553	B1	7/2004	Odamura
D495,336	S	8/2004	Andre et al.
6,770,863	B2	8/2004	Walley
6,773,325	B1	8/2004	Mawle et al.
6,773,344	B1	8/2004	Gabai et al.
6,785,539	B2	8/2004	Hale
6,786,877	B2	9/2004	Foxlin
6,796,177	B2	9/2004	Mori
6,796,908	B2	9/2004	Weston
6,797,895	B2	9/2004	Lapstun
6,811,489	B1	11/2004	Shimizu
6,811,491	B1	11/2004	Levenberg et al.
6,812,583	B2	11/2004	Cheung et al.
6,812,881	B1	11/2004	Mullaly et al.
6,813,525	B2	11/2004	Reid
6,813,574	B1	11/2004	Yedur
6,813,584	B2	11/2004	Zhou et al.
6,816,151	B2	11/2004	Dellinger
6,821,204	B2	11/2004	Aonuma et al.
6,821,206	B1	11/2004	Ishida et al.
6,835,135	B1	12/2004	Silverbrook et al.
6,836,705	B2	12/2004	Hellman
6,836,751	B2	12/2004	Paxton
6,836,971	B1	1/2005	Wan
6,842,991	B2	1/2005	Levi
6,846,238	B2	1/2005	Wells
6,850,221	B1	2/2005	Tickle
6,850,844	B1	2/2005	Walters
6,852,032	B2	2/2005	Ishino
6,856,327	B2	2/2005	Choi
D502,468	S	3/2005	Knight et al.
6,868,738	B2	3/2005	Moscrip
6,872,139	B2	3/2005	Sato et al.
6,873,406	B1	3/2005	Hines
D503,750	S	4/2005	Kit et al.
6,878,066	B2	4/2005	Leifer
6,882,824	B2	4/2005	Wood
D504,677	S	5/2005	Kaminski et al.
D505,424	S	5/2005	Ashida et al.
6,890,262	B2	5/2005	Oishi
6,891,526	B2	5/2005	Gombert
6,894,686	B2	5/2005	Stamper et al.
6,897,845	B2	5/2005	Ozawa
6,897,854	B2	5/2005	Cho
6,902,483	B2	6/2005	Lin
6,903,725	B2	6/2005	Nacson
6,905,411	B2	6/2005	Nguyen et al.
6,906,700	B1	6/2005	Armstrong
6,908,386	B2	6/2005	Suzuki et al.
6,908,388	B2	6/2005	Shimizu
6,918,833	B2	7/2005	Emmerson et al.
6,921,332	B2	7/2005	Fukunaga
6,922,632	B2	7/2005	Foxlin
6,924,787	B2	8/2005	Kramer et al.
6,925,410	B2	8/2005	Narayanan
6,929,543	B1	8/2005	Ueshima et al.
6,929,548	B2	8/2005	Wang
6,932,698	B2	8/2005	Sprogis
6,932,706	B1	8/2005	Kaminkow
6,933,861	B2	8/2005	Wang
6,933,923	B2	8/2005	Feinstein
6,935,864	B2	8/2005	Shechter et al.
6,935,952	B2	8/2005	Walker et al.
6,939,232	B2	9/2005	Tanaka et al.
6,948,999	B2	9/2005	Chan
6,954,980	B2	10/2005	Song
6,955,606	B2	10/2005	Taho et al.
6,956,564	B1	10/2005	Williams
6,965,374	B2	11/2005	Villet et al.
6,966,775	B1	11/2005	Kendir et al.
6,967,563	B2	11/2005	Bormaster
6,967,566	B2	11/2005	Weston et al.
6,982,697	B2	1/2006	Wilson et al.
6,983,219	B2	1/2006	Mantyjarvi
6,984,208	B2	1/2006	Zheng
6,990,639	B2	1/2006	Wilson
6,993,451	B2	1/2006	Chang et al.
6,995,748	B2	2/2006	Gordon et al.
6,998,966	B2	2/2006	Pedersen
7,000,469	B2	2/2006	Foxlin et al.
7,002,591	B1	2/2006	Leather
7,004,847	B2	2/2006	Henry
7,029,400	B2	4/2006	Briggs
7,031,875	B2	4/2006	Ellenby et al.
7,040,986	B2	5/2006	Koshima
7,040,993	B1	5/2006	Lovitt
7,040,998	B2	5/2006	Jolliffe et al.
7,052,391	B1	5/2006	Luciano, Jr.
7,055,101	B2	5/2006	Abbott et al.
7,056,221	B2	6/2006	Thirkettle et al.
7,059,974	B1	6/2006	Golliffe et al.
7,066,781	B2	6/2006	Weston
D524,298	S	7/2006	Hedderich et al.
7,081,033	B1	7/2006	Mawle
7,081,051	B2	7/2006	Himoto et al.
7,086,645	B2	8/2006	Hardie
7,090,582	B2	8/2006	Danieli et al.
7,094,147	B2	8/2006	Nakata
7,098,891	B1	8/2006	Pryor
7,098,894	B2	8/2006	Yang
7,102,615	B2	9/2006	Marks
7,102,616	B1	9/2006	Sleator
7,107,168	B2	9/2006	Oystol
D531,228	S	10/2006	Ashida et al.
7,115,032	B2	10/2006	Cantu et al.
7,117,009	B2	10/2006	Wong et al.
7,118,482	B2	10/2006	Ishihara et al.
7,126,584	B1	10/2006	Nishiumi et al.
7,127,370	B2	10/2006	Kelly
D531,585	S	11/2006	Weitgasser et al.
7,133,026	B2	11/2006	Horie et al.
7,136,674	B2	11/2006	Yoshie et al.
7,136,826	B2	11/2006	Alsafadi
7,137,899	B2	11/2006	Hiei
7,139,983	B2	11/2006	Kelts
7,140,962	B2	11/2006	Okuda et al.
7,142,191	B2	11/2006	Idesawa et al.
7,145,551	B1	12/2006	Bathiche
7,149,627	B2	12/2006	Ockerse
7,154,475	B2	12/2006	Crew
7,155,604	B2	12/2006	Kawai
7,158,116	B2	1/2007	Poltorak
7,158,118	B2	1/2007	Liberty
7,160,196	B2	1/2007	Thirkettle et al.
7,168,089	B2	1/2007	Nguyen et al.
7,173,604	B2	2/2007	Marvit
7,176,919	B2	2/2007	Drebin
7,180,414	B2	2/2007	Nyfelt
7,180,503	B2	2/2007	Burr
7,182,691	B1	2/2007	Schena
7,183,480	B2	2/2007	Nishitani et al.
7,184,059	B1	2/2007	Fouladi
D538,790	S	3/2007	Okada
D543,246	S	5/2007	Ashida et al.
7,220,220	B2	5/2007	Stubbs et al.
7,223,173	B2	5/2007	Masuyama et al.
7,225,101	B2	5/2007	Usuda et al.
7,231,063	B2	6/2007	Naimark
7,233,316	B2	6/2007	Smith et al.
7,236,156	B2	6/2007	Liberty et al.
7,239,301	B2	7/2007	Liberty et al.
7,252,572	B2	8/2007	Wright et al.
7,261,690	B2	8/2007	Teller et al.
7,262,760	B2	8/2007	Liberty
RE39,818	E	9/2007	Slifer
7,288,028	B2	10/2007	Rodriquez et al.
D556,201	S	11/2007	Ashida et al.
7,291,014	B2	11/2007	Chung et al.
7,292,151	B2	11/2007	Ferguson et al.
7,297,059	B2	11/2007	Vancura et al.
7,301,527	B2	11/2007	Marvit
7,301,648	B2	11/2007	Foxlin

(56) **References Cited**

U.S. PATENT DOCUMENTS

D556,760 S	12/2007	Ashida et al.
7,307,617 B2	12/2007	Wilson et al.
D559,847 S	1/2008	Ashida et al.
D561,178 S	2/2008	Azuma
7,331,857 B2	2/2008	MacIver
7,335,134 B1	2/2008	LaVelle
D563,948 S	3/2008	d-Hoore
7,337,965 B2	3/2008	Thirkettle et al.
7,339,105 B2	3/2008	Eitaki
7,345,670 B2	3/2008	Armstrong
D567,243 S	4/2008	Ashida et al.
7,359,121 B2	4/2008	French et al.
7,359,451 B2	4/2008	McKnight
7,361,073 B2	4/2008	Martin
RE40,324 E	5/2008	Crawford
7,379,566 B2	5/2008	Hildreth
7,387,559 B2	6/2008	Sanchez-Castro et al.
7,395,181 B2	7/2008	Foxlin
7,398,151 B1	7/2008	Burrell et al.
7,408,453 B2	8/2008	Breed
7,414,611 B2	8/2008	Liberty
7,419,428 B2	9/2008	Rowe
7,424,388 B2	9/2008	Sato
7,428,499 B1	9/2008	Philyaw
7,435,179 B1	10/2008	Ford
7,441,151 B2	10/2008	Whitten et al.
7,442,108 B2	10/2008	Ganz
7,445,550 B2	11/2008	Barney et al.
7,465,212 B2	12/2008	Ganz
7,488,231 B2	2/2009	Weston
7,488,254 B2	2/2009	Himoto
7,489,299 B2	2/2009	Liberty et al.
7,492,268 B2	2/2009	Ferguson et al.
7,492,367 B2	2/2009	Mahajan et al.
7,500,917 B2	3/2009	Barney et al.
7,502,759 B2	3/2009	Hannigan et al.
7,519,537 B2	4/2009	Rosenberg
7,524,246 B2	4/2009	Briggs et al.
7,535,456 B2	5/2009	Liberty et al.
7,536,156 B2	5/2009	Tischer
7,564,426 B2	7/2009	Poor
7,568,289 B2	8/2009	Burlingham et al.
7,572,191 B2	8/2009	Weston et al.
7,582,016 B2	9/2009	Suzuki
7,596,466 B2	9/2009	Ohta
7,614,958 B2	11/2009	Weston et al.
7,623,115 B2	11/2009	Marks
7,627,139 B2	12/2009	Marks
7,627,451 B2	12/2009	Vock
7,662,015 B2	2/2010	Hui
7,663,509 B2	2/2010	Shen
7,674,184 B2	3/2010	Briggs et al.
7,704,135 B2	4/2010	Harrison
7,727,090 B2	6/2010	Gant
7,749,089 B1	7/2010	Briggs et al.
7,774,155 B2	8/2010	Sato et al.
7,775,882 B2	8/2010	Kawamura et al.
7,775,884 B1	8/2010	McCauley
7,789,741 B1	9/2010	Fields
7,796,116 B2	9/2010	Salsman et al.
7,828,295 B2	11/2010	Matsumoto et al.
7,850,527 B2	12/2010	Barney et al.
7,878,905 B2	2/2011	Weston et al.
7,883,420 B2	2/2011	Bradbury
7,896,742 B2	3/2011	Barney et al.
7,927,216 B2	4/2011	Ikeda
7,942,745 B2	5/2011	Ikeda
7,989,971 B2	8/2011	Lemieux
8,021,239 B2	9/2011	Weston et al.
8,025,573 B2	9/2011	Stenton et al.
8,089,458 B2	1/2012	Barney et al.
8,164,567 B1	4/2012	Barney et al.
8,169,406 B2	5/2012	Barney et al.
8,184,097 B1	5/2012	Barney et al.
8,226,493 B2	7/2012	Briggs et al.
8,248,367 B1	8/2012	Barney et al.
8,287,373 B2	10/2012	Marks et al.
8,342,929 B2	1/2013	Briggs et al.
8,368,648 B2	2/2013	Barney et al.
8,373,659 B2	2/2013	Barney et al.
8,384,668 B2	2/2013	Barney et al.
8,475,275 B2	7/2013	Weston et al.
8,491,389 B2	7/2013	Weston et al.
8,531,050 B2	9/2013	Barney et al.
2001/0010514 A1	8/2001	Ishino
2001/0015123 A1	8/2001	Nishitani et al.
2001/0018361 A1	8/2001	Acres
2001/0024973 A1	9/2001	Meredith
2001/0031662 A1	10/2001	Larian
2001/0034257 A1	10/2001	Weston et al.
2001/0039206 A1	11/2001	Peppel
2001/0040591 A1	11/2001	Abbott et al.
2001/0049302 A1	12/2001	Hagiwara et al.
2001/0054082 A1	12/2001	Rudolph et al.
2002/0005787 A1	1/2002	Gabai et al.
2002/0008622 A1	1/2002	Weston et al.
2002/0024500 A1	2/2002	Howard
2002/0024675 A1	2/2002	Foxlin
2002/0028071 A1	3/2002	Molgaard
2002/0028710 A1	3/2002	Ishihara et al.
2002/0032067 A1	3/2002	Barney
2002/0036617 A1	3/2002	Pryor
2002/0038267 A1	3/2002	Can et al.
2002/0052238 A1	5/2002	Muroi
2002/0058459 A1	5/2002	Holt
2002/0068500 A1	6/2002	Gabai et al.
2002/0072418 A1	6/2002	Masuyama
2002/0075335 A1	6/2002	Rekimoto
2002/0090985 A1	7/2002	Tochner et al.
2002/0090992 A1	7/2002	Legge et al.
2002/0098887 A1	7/2002	Himoto et al.
2002/0103026 A1	8/2002	Himoto et al.
2002/0107069 A1	8/2002	Ishino
2002/0107591 A1	8/2002	Gabai et al.
2002/0116615 A1	8/2002	Nguyen et al.
2002/0118147 A1	8/2002	Solomon
2002/0123377 A1	9/2002	Shulman
2002/0126026 A1	9/2002	Lee et al.
2002/0128056 A1	9/2002	Kato
2002/0137427 A1	9/2002	Peters
2002/0137567 A1	9/2002	Cheng
2002/0140745 A1	10/2002	Ellenby
2002/0158751 A1	10/2002	Bormaster
2002/0158843 A1	10/2002	Levine
2002/0183961 A1	12/2002	French et al.
2002/0193047 A1	12/2002	Weston
2003/0013513 A1	1/2003	Rowe
2003/0022736 A1	1/2003	Cass
2003/0027634 A1	2/2003	Matthews, III
2003/0036425 A1	2/2003	Kaminkow et al.
2003/0037075 A1	2/2003	Hannigan
2003/0038778 A1	2/2003	Noguera
2003/0040347 A1	2/2003	Roach et al.
2003/0052860 A1	3/2003	Park et al.
2003/0057808 A1	3/2003	Lee et al.
2003/0060286 A1	3/2003	Walker et al.
2003/0063068 A1	4/2003	Anton
2003/0064812 A1	4/2003	Rappaport et al.
2003/0069077 A1	4/2003	Korienek
2003/0073505 A1	4/2003	Tracy
2003/0095101 A1	5/2003	Jou
2003/0096652 A1	5/2003	Siegel et al.
2003/0106455 A1	6/2003	Weston
2003/0107178 A1	6/2003	Weston
2003/0107551 A1	6/2003	Dunker
2003/0134679 A1	7/2003	Siegel et al.
2003/0144047 A1	7/2003	Sprogis
2003/0144056 A1	7/2003	Leifer et al.
2003/0166416 A1	9/2003	Ogata
2003/0171145 A1	9/2003	Rowe
2003/0171190 A1	9/2003	Rice
2003/0190967 A1	10/2003	Henry
2003/0193572 A1	10/2003	Wilson et al.
2003/0195037 A1	10/2003	Vuong et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2003/0195041	A1	10/2003	McCauley
2003/0195046	A1	10/2003	Bartsch
2003/0204361	A1	10/2003	Townsend
2003/0214259	A9	11/2003	Dowling et al.
2003/0216176	A1	11/2003	Shimizu
2003/0222851	A1	12/2003	Lai
2003/0234914	A1	12/2003	Solomon
2004/0028258	A1	2/2004	Naimark
2004/0033833	A1	2/2004	Briggs et al.
2004/0034289	A1	2/2004	Teller et al.
2004/0048666	A1	3/2004	Bagley
2004/0063480	A1	4/2004	Wang
2004/0070564	A1	4/2004	Dawson
2004/0075650	A1	4/2004	Paul
2004/0077423	A1	4/2004	Weston et al.
2004/0081313	A1	4/2004	McKnight et al.
2004/0092311	A1	5/2004	Weston et al.
2004/0095317	A1	5/2004	Zhang
2004/0102247	A1	5/2004	Smoot et al.
2004/0119693	A1	6/2004	Kaemmler
2004/0121834	A1	6/2004	Libby et al.
2004/0134341	A1	7/2004	Sandoz
2004/0140954	A1	7/2004	Faeth
2004/0143413	A1	7/2004	Oystol
2004/0147317	A1	7/2004	Ito et al.
2004/0152499	A1	8/2004	Lind et al.
2004/0152515	A1	8/2004	Wegmuller et al.
2004/0174287	A1	9/2004	Deak
2004/0193413	A1	9/2004	Wilson
2004/0198158	A1	10/2004	Driscoll et al.
2004/0198517	A1	10/2004	Briggs
2004/0203638	A1	10/2004	Chan
2004/0204240	A1	10/2004	Barney
2004/0207597	A1	10/2004	Marks
2004/0214642	A1	10/2004	Beck
2004/0218104	A1	11/2004	Smith
2004/0222969	A1	11/2004	Buchenrieder
2004/0227725	A1	11/2004	Calarco
2004/0229693	A1	11/2004	Lind
2004/0229696	A1	11/2004	Beck
2004/0236453	A1	11/2004	Szoboszlay
2004/0239626	A1	12/2004	Noguera
2004/0252109	A1	12/2004	Trent et al.
2004/0254020	A1	12/2004	Dragusin
2004/0259651	A1	12/2004	Storek
2004/0268393	A1	12/2004	Hunleth
2005/0017454	A1	1/2005	Endo et al.
2005/0020369	A1	1/2005	Davis
2005/0032582	A1	2/2005	Mahajan et al.
2005/0047621	A1	3/2005	Cranfill
2005/0054457	A1	3/2005	Eyestone
2005/0059488	A1	3/2005	Larsen et al.
2005/0059503	A1	3/2005	Briggs et al.
2005/0060586	A1	3/2005	Burger
2005/0076161	A1	4/2005	Albanna
2005/0085298	A1	4/2005	Woolston
2005/0116020	A1	6/2005	Smolucha et al.
2005/0125826	A1	6/2005	Hunleth
2005/0127868	A1	6/2005	Calhoon et al.
2005/0130739	A1	6/2005	Argentar
2005/0134555	A1	6/2005	Liao
2005/0138851	A1	6/2005	Ingraselino
2005/0143173	A1	6/2005	Barney et al.
2005/0156883	A1	7/2005	Wilson et al.
2005/0162389	A1	7/2005	Obermeyer
2005/0164601	A1	7/2005	McEachen
2005/0170889	A1	8/2005	Lum et al.
2005/0172734	A1	8/2005	Alsio
2005/0174324	A1	8/2005	Liberty
2005/0176485	A1	8/2005	Ueshima
2005/0179644	A1	8/2005	Alsio
2005/0210418	A1	9/2005	Marvit
2005/0210419	A1	9/2005	Kela
2005/0212749	A1	9/2005	Marvit
2005/0212750	A1	9/2005	Marvit
2005/0212751	A1	9/2005	Marvit
2005/0212752	A1	9/2005	Marvit
2005/0212753	A1	9/2005	Marvit
2005/0212754	A1	9/2005	Marvit
2005/0212755	A1	9/2005	Marvit
2005/0212756	A1	9/2005	Marvit
2005/0212757	A1	9/2005	Marvit
2005/0212758	A1	9/2005	Marvit
2005/0212759	A1	9/2005	Marvit
2005/0212760	A1	9/2005	Marvit
2005/0212764	A1	9/2005	Toba
2005/0212767	A1	9/2005	Marvit
2005/0215295	A1	9/2005	Arneson
2005/0215322	A1	9/2005	Himoto et al.
2005/0217525	A1	10/2005	McClure
2005/0227579	A1	10/2005	Yamaguchi et al.
2005/0233808	A1	10/2005	Himoto et al.
2005/0239548	A1	10/2005	Ueshima et al.
2005/0243061	A1	11/2005	Liberty
2005/0243062	A1	11/2005	Liberty
2005/0253806	A1	11/2005	Liberty
2005/0256675	A1	11/2005	Kurata
2005/0266907	A1	12/2005	Weston et al.
2005/0277465	A1	12/2005	Whitten et al.
2005/0278741	A1	12/2005	Robarts
2006/0007115	A1	1/2006	Furuhashi
2006/0028446	A1	2/2006	Liberty
2006/0030385	A1	2/2006	Barney et al.
2006/0040720	A1	2/2006	Harrison
2006/0046849	A1	3/2006	Kovacs
2006/0092133	A1	5/2006	Touma
2006/0094502	A1	5/2006	Katayama et al.
2006/0122474	A1	6/2006	Teller et al.
2006/0123146	A1	6/2006	Wu et al.
2006/0148563	A1	7/2006	Yang
2006/0152487	A1	7/2006	Grunnet-Jepsen
2006/0152488	A1	7/2006	Salsman
2006/0152489	A1	7/2006	Sweetser
2006/0154726	A1	7/2006	Weston et al.
2006/0178212	A1	8/2006	Penzias
2006/0205507	A1	9/2006	Ho
2006/0229134	A1	10/2006	Briggs et al.
2006/0231794	A1	10/2006	Sakaguchi et al.
2006/0234601	A1	10/2006	Weston
2006/0252475	A1	11/2006	Zalewski
2006/0252477	A1	11/2006	Zalewski et al.
2006/0256081	A1	11/2006	Zalewski
2006/0258452	A1	11/2006	Hsu
2006/0258471	A1	11/2006	Briggs et al.
2006/0264258	A1	11/2006	Zalewski et al.
2006/0264260	A1	11/2006	Zalewski
2006/0267935	A1	11/2006	Corson
2006/0273907	A1	12/2006	Heiman
2006/0282873	A1	12/2006	Zalewski
2006/0284842	A1	12/2006	Poltorak
2006/0287030	A1	12/2006	Briggs et al.
2006/0287084	A1	12/2006	Mao et al.
2006/0287085	A1	12/2006	Mao
2006/0287086	A1	12/2006	Zalewski
2006/0287087	A1	12/2006	Zalewski
2007/0015588	A1	1/2007	Matsumoto et al.
2007/0021208	A1	1/2007	Mao et al.
2007/0049374	A1	3/2007	Ikeda et al.
2007/0050597	A1	3/2007	Ikeda et al.
2007/0052177	A1	3/2007	Ikeda et al.
2007/0060391	A1	3/2007	Ikeda et al.
2007/0066394	A1	3/2007	Ikeda et al.
2007/0066396	A1	3/2007	Weston et al.
2007/0072680	A1	3/2007	Ikeda et al.
2007/0091084	A1	4/2007	Ueshima et al.
2007/0093291	A1	4/2007	Hulvey
2007/0100696	A1	5/2007	Illingworth
2007/0159362	A1	7/2007	Shen
2007/0173705	A1	7/2007	Teller et al.
2007/0249425	A1	10/2007	Weston et al.
2007/0252815	A1	11/2007	Kuo
2007/0257884	A1	11/2007	Taira
2007/0265075	A1	11/2007	Zalewski
2007/0265076	A1	11/2007	Lin

(56) **References Cited**

U.S. PATENT DOCUMENTS

2007/0265088	A1	11/2007	Nakada et al.
2008/0014835	A1	1/2008	Weston et al.
2008/0015017	A1	1/2008	Ashida et al.
2008/0039202	A1	2/2008	Sawano et al.
2008/0119270	A1	5/2008	Ohta
2008/0121782	A1	5/2008	Hotelling et al.
2008/0174550	A1	7/2008	Laurila
2008/0183678	A1	7/2008	Weston
2008/0273011	A1	11/2008	Lin
2008/0278445	A1	11/2008	Sweetser
2009/0009294	A1	1/2009	Kupstas
2009/0033621	A1	2/2009	Quinn
2009/0051653	A1	2/2009	Barney et al.
2009/0124165	A1	5/2009	Weston
2009/0156309	A1	6/2009	Weston et al.
2009/0215534	A1	8/2009	Wilson et al.
2009/0305799	A1	12/2009	Weston et al.
2009/0326851	A1	12/2009	Tanenhaus
2010/0056285	A1	3/2010	Weston et al.
2010/0105475	A1	4/2010	Mikhailov
2010/0144436	A1	6/2010	Marks et al.
2010/0203932	A1	8/2010	Briggs et al.
2010/0273556	A1	10/2010	Briggs et al.
2010/0289744	A1	11/2010	Cohen
2011/0081969	A1	4/2011	Ikeda
2011/0081970	A1	4/2011	Barney et al.
2011/0177853	A1	7/2011	Ueshima
2011/0190052	A1	8/2011	Takeda
2011/0263330	A1	10/2011	Weston et al.
2011/0300941	A1	12/2011	Weston et al.
2012/0004031	A1	1/2012	Barney et al.
2012/0034980	A1	2/2012	Weston et al.
2012/0094759	A1	4/2012	Barney et al.
2012/0122575	A1	5/2012	Barney et al.
2012/0190452	A1	7/2012	Weston et al.
2012/0208638	A1	8/2012	Barney et al.
2012/0258802	A1	10/2012	Weston et al.
2012/0270657	A1	10/2012	Barney et al.
2012/0295710	A1	11/2012	Barney et al.
2012/0309528	A1	12/2012	Barney et al.
2013/0079141	A1	3/2013	Barney et al.
2013/0116048	A1	5/2013	Briggs et al.
2013/0116051	A1	5/2013	Barney et al.
2013/0150155	A1	6/2013	Barney et al.
2013/0165228	A1	6/2013	Barney et al.
2013/0196727	A1	8/2013	Barney et al.
2013/0217453	A1	8/2013	Briggs et al.

FOREIGN PATENT DOCUMENTS

CN	1559644		1/2005
DE	3930581		3/1991
DE	19701374		7/1997
DE	19632273		2/1998
DE	19648487		6/1998
DE	19814254		10/1998
DE	19937307		2/2000
DE	10029173		1/2002
DE	10219198		11/2003
EP	0264782	A2	4/1988
EP	0570999		12/1988
EP	0322825	A2	7/1989
EP	0546844		6/1993
EP	0695565	A1	2/1996
EP	0835676		4/1998
EP	0848226		6/1998
EP	0852961		7/1998
EP	1062994		12/2000
EP	1279425		1/2003
EP	1293237		3/2003
EP	0993845		12/2005
FR	2547093	A1	12/1984
GB	2244546		12/1991
GB	2284478		6/1995
GB	2307133		5/1997
GB	2310481		8/1997
GB	2316482		2/1998
GB	2319374		5/1998
GB	2325558	A	11/1998
GB	2388418		11/2003
JP	62-14527		1/1987
JP	63-186687		8/1988
JP	03-210622		9/1991
JP	06-050758		2/1994
JP	06-154422		6/1994
JP	06-190144		7/1994
JP	06-198075		7/1994
JP	H0677387		10/1994
JP	06-308879		11/1994
JP	07-028591		1/1995
JP	07-044315		2/1995
JP	07-107573		4/1995
JP	07-115690		5/1995
JP	07-146123		6/1995
JP	07-200142		8/1995
JP	07-262797		10/1995
JP	07-302148		11/1995
JP	07-318332		12/1995
JP	08-095704		4/1996
JP	08-106352		4/1996
JP	08-111144		4/1996
JP	08-114415		5/1996
JP	08-122070		5/1996
JP	08-152959		6/1996
JP	08-191953		7/1996
JP	08-211993		8/1996
JP	08-221187		8/1996
JP	08-305355		11/1996
JP	08-335136		12/1996
JP	09-149915		6/1997
JP	09-164273		6/1997
JP	09-34456		7/1997
JP	09-230997		9/1997
JP	09-237087		9/1997
JP	09-274534		10/1997
JP	09-319510		12/1997
JP	10-021000		1/1998
JP	10-033831		2/1998
JP	10 043349	A	2/1998
JP	10-099542		4/1998
JP	10-154038		6/1998
JP	10-235019		8/1998
JP	10-254614		9/1998
JP	11-053994		2/1999
JP	11-099284		4/1999
JP	11-114223		4/1999
JP	2000-33184		2/2000
JP	2000-176150		6/2000
JP	2000-270237		9/2000
JP	2000-300839		10/2000
JP	2000-308756		11/2000
JP	2000-325653		11/2000
JP	2001-038052		2/2001
JP	2001-058484		3/2001
JP	2001-104643		4/2001
JP	U20009165		4/2001
JP	2001-175412		6/2001
JP	2001-251324		9/2001
JP	2001-265521		9/2001
JP	2001-306245		11/2001
JP	2002-07057		1/2002
JP	2002-062981		2/2002
JP	2002-078969		3/2002
JP	2002-082751		3/2002
JP	2002-091692		3/2002
JP	2002-126375		5/2002
JP	2002-136694		5/2002
JP	2002-153673		5/2002
JP	2002-202843		7/2002
JP	2002-224444		8/2002
JP	2002-233665		8/2002
JP	2002-298145		10/2002
JP	2003-053038		2/2003

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

JP	2003-140823		5/2003
JP	2003-208263		7/2003
JP	2003-236246		8/2003
JP	2003-325974		11/2003
JP	2004-062774		2/2004
JP	2004-313429		11/2004
JP	2004-313492		11/2004
JP	2005-040493		2/2005
JP	2005-063230		3/2005
JP	2006-113019		4/2006
JP	2006-136694		6/2006
JP	2006-216569		8/2006
JP	2007-083024		4/2007
NL	9300171		8/1994
RU	2077358	C1	4/1997
RU	2125853		2/1999
RU	2126161		2/1999
WO	WO 94/02931		3/1994
WO	WO 95/11730	A1	5/1995
WO	WO 96/05766		2/1996
WO	WO 96/14115		5/1996
WO	WO 96/14121		5/1996
WO	WO 97/09101		3/1997
WO	WO 97/12337		4/1997
WO	WO 97/17598		5/1997
WO	WO 97/20305		6/1997
WO	PCT/US97/01811		8/1997
WO	WO 97/28864		8/1997
WO	WO 97/32641		9/1997
WO	WO 98/11528		3/1998
WO	WO 98/36400		8/1998
WO	WO 99/58214		11/1999
WO	WO 00/33168		6/2000
WO	WO 00/35345		6/2000
WO	WO 00/61251		10/2000
WO	WO 00/63874		10/2000
WO	WO 00/67863		11/2000
WO	WO 01/87426		11/2001
WO	WO 01/91042		11/2001
WO	WO 02/17054		2/2002
WO	WO 02/34345		5/2002
WO	WO 02/47013		6/2002
WO	WO 03/015005		2/2003
WO	WO 03/043709		5/2003
WO	WO 03/044743		5/2003
WO	WO 03/088147		10/2003
WO	WO 03/107260		12/2003
WO	WO 2004/039055		5/2004
WO	WO 2004/051391		6/2004
WO	WO 2004/087271		10/2004
WO	WO 2006/039339		4/2006
WO	WO 2006/101880		9/2006
WO	WO 2007/058996		5/2007
WO	WO 2007/120880		10/2007

OTHER PUBLICATIONS

Achenbach, "Golfs New Measuring Stick," Golfweek, Jun. 11, 2005.

Agard, "Advances in Strapdown Inertial Systems," Agard Lecture Series No. 133, Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France) (1984).

Algrain, "Estimation of 3-D Angular Motion Using Gyroscopes and Linear Accelerometers," IEEE Transactions on Aerospace and Electronic Systems, vol. 27, No. 6, pp. 910-920 (Nov. 1991).

Algrain, et al., "Accelerometer Based Line-of-Sight Stabilization Approach for Pointing and Tracking System," Second IEEE Conference on Control Applications, Sep. 13-16, 1993 Vancouver, B.C., pp. 159-163 (1993).

Algrain, et al., "Interlaced Kalman Filtering of 3-D Angular Motion Based on Euler's Nonlinear Equations," IEEE Transactions on Aerospace and Electronic Systems, vol. 30, No. 1 (Jan. 1994).

Allen, et al., "A General Method for Comparing the Expected Performance of Tracing and Motion Capture Systems," {VRST} '05: Proceedings of the ACM Symposium on Virtual Reality Software and Technology, Nov. 7-9, 2005 Monterey, California (2005).

Allen, et al., "Tracking: Beyond 15 Minutes of Thought," SIGGRAPH 2001 Course 11 (2001).

Ang, et al., "Design and Implementation of Active Error Canceling in Hand-held Microsurgical Instrument," Paper presented at 2001 IEEE/RSJ International Conference on Intelligent Robots and Systems (2001).

Ang, et al., "Design of All-Accelerometer Inertial Measurement Unit for Tremor Sensing in Hand-held Microsurgical Instrument," Proceedings of the 2003 IEEE International Conference on Robotics & Automation, Sep. 14-19, 2003, Taipei, Taiwan, pp. 1781-1786 (2003).

Apostolyuk, Vladislav, "Theory and Design of Micromechanical Vibratory Gyroscopes," MEMS/NEMS Handbook, Springer, vol. 1, pp. 173-195 (2006).

Ator, "Image-Velocity Sensing with Parallel-Slit Reticles," Journal of the Optical Society of America, vol. 53, No. 12, pp. 1416-1422 (Dec. 1963).

Azarbayejani, et al, "Real-Time 3-D Tracking of the Human Body," M.I.T. Media Laboratory Perceptual Computing Section Technical Report No. 374, Appears in Proceedings of Image'Com 96, Bordeaux, France, May 1996.

Azarbayejani, et al., "Visually Controlled Graphics," M.I.T. Media Laboratory Perceptual Computing Section Technical Report No. 374, Appears in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 15, No. 6, pp. 602-605 (Jun. 1993).

Azuma et al., "Improving Static and Dynamic Registration in an Optical See-Through HMD," Paper Presented at SIGGRAPH '94 Annual Conference in Orlando, FL (1994).

Azuma et al., "Making Augmented Reality Work Outdoors Requires Hybrid Tracking," Proceedings of the International Workshop on Augmented Reality, San Francisco, CA, Nov. 1, 1998.

Azuma, "Predictive Tracking for Augmented Reality," Ph.D. Dissertation, University of North Carolina at Chapel Hill, Department of Computer Science (1995).

Azuma, et al., "A Frequency-Domain Analysis of Head-Motion Prediction," Paper Presented at SIGGRAPH '95 Annual Conference in Los Angeles, CA (1995).

Azuma, et al., "A motion-stabilized outdoor augmented reality system," Proceedings of IEEE Virtual Reality '99, Houston, TX, Mar. 13-17, 1999, pp. 252-259.

Bachmann et al., "Inertial and Magnetic Posture Tracking for Inserting Humans into Networked Virtual Environments," Virtual Reality Software and Technology archive, Paper Presented at ACM Symposium on Virtual Reality Software and Technology in Banff, Alberta, Canada (2001).

Bachmann et al., "Orientation Tracking for Humans and Robots Using Inertial Sensors" Paper Presented at 199 International Symposium on Computational Intelligence in Robotics & Automation (CIRA '99) (1999).

Bachmann, "Inertial and Magnetic Angle Tracking of Limb Segments for Inserting Humans into Synthetic Environments," Dissertation, Naval Postgraduate School, Monterey, CA (Dec. 2000).

Badler et al., "Multi-Dimensional Input Techniques and Articulated Figure Positioning by Multiple Constraints," Interactive 3D Graphics, Oct. 1986; pp. 151-169.

Baker et al., "Active Multimodal Control of a 'Floppy' Telescope Structure," Proc. SPIE, vol. 4825, pp. 74-81 (2002).

Balakrishnan, "The Rockin' Mouse: Integral 3D Manipulation on a Plane," Published in Proceedings of 1997 ACM Conference on Human Factors in Computing Systems (CHI'97), pp. 311-318, (1997).

Ballagas, et al., "iStuff: A Physical User Interface Toolkit for Ubiquitous Computer Environments," Paper presented at SIGCHI Conference on Human Factors in Computing Systems (2003).

Baraff, "An Introduction to Physically Based Modeling: Rigid Body Simulation I—Unconstrained Rigid Body Dynamics," SIGGRAPH 97 Course Notes, Robotics Institute, Carnegie Mellon University (1997).

Baudisch, et al., "Soap: a Pointing Device that Works in Mid-air," Proc. UIST'06, Oct. 15-18, 2006, Montreux, Switzerland (2006).

(56) **References Cited**

OTHER PUBLICATIONS

Beh Ringer, "Improving the Registration Precision by Visual Horizon Silhouette Matching," Paper presented at First IEEE Workshop on Augmented Reality (1998).
Behringer, "Registration for Outdoor Augmented Reality Applications Using Computer Vision Techniques and Hybrid Sensors," Paper presented at IEEE Virtual Reality (VR '99) Conference in Houston, TX (1999).
Benbasat, "An Inertial Measurement Unit for User Interfaces," Massachusetts Institute of Technology Masters Thesis, (Sep. 2000).
Benbasat, et al., "An Inertial Measurement Framework for Gesture Recognition and Applications," Paper Presented at International Gesture Workshop on Gesture and Sign Languages in Human-Computer Interaction (GW '01), London, UK (2001).
Bhatnagar, "Position trackers for Head Mounted Display systems: A survey" (Technical Report), University of North Carolina at Chapel Hill (Mar. 1993).
Bianchi, "A Tailless Mouse, New cordless Computer Mouse Invented by ArcanaTech," Inc.com, Jun. 1, 1992 (accessed at http://www.inc.com/magazine/19920601/4115.html on Jun. 17, 2010).
Bishop, "The Self-Tracker: A Smart Optical Sensor on Silicon," Ph.D. Dissertation, Univ. Of North Carolina at Chapel Hill (1984).
Bjork, Staffan et al., "Pirates! Using the Physical World as a Game Board," Reportedly presented as part of Interact 2001: 8th TC.13 IFIP International Conference on Human-Computer Interaction, Tokyo Japan (Jul. 9-13, 2001).
Bona, et al., "Optimum Reset of Ship's Inertial Navigation System," IEEE Transactions on Aerospace and Electronic Systems, Abstract only (1965) (accessed at http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=AD0908193 on Jun. 17, 2010).
Borenstein, et al., "Where am I? Sensors and Methods for Mobile Robot Positioning" (1996).
Borovoy, R. et al., "Things that Blink: Computationally Augmented Name Tags," IBM Systems Journal, vol. 35, Nos. 3 & 4, 1996; pp. 488-495.
Borovoy, Richard et al., "Groupwear: Nametags That Tell About Relationships," Chi 98, Apr. 1998, pp. 329-330.
Boser, "3-Axis Accelerometer with Differential Sense Electronics," Berkeley Sensor & Actuator Center, available at http://www.eecs.berkeley.edu/.about.boser/pdf/3axis.pdf (1997).
Boser, "Accelerometer Design Example: Analog Devices XL-05/5," Berkeley Sensor & Actuator Center, available at http://wvvw.eecs.berkeley.edu/.about.boser/pdf/xl05.pdf (1996).
Boulanger et al., "The 1997 Mathews Radio-Baton and Improvisation Modes," Music Synthesis Department, Berklee College of Music (1997).
Bowman, et al., "An Introduction to 3-D User Interface Design," MIT Presence, vol. 10, No. 1, pp. 96-108 (Feb. 2001).
Britton et al., "Making Nested Rotations Convenient for the User," SIGGRAPH '78 Proceedings of the 5th Annual Conference on Computer Graphics and Interactive Techniques, vol. 12, Issue 3, pp. 222-227 (Aug. 1978).
Britton, "A Methodology for the Ergonomic Design of Interactive Computer Graphic Systems, and its Application to Crystallography" Ph.D. Dissertation, University of North Carolina at Chapel Hill, Dept. of Computer Science (1977).
Brownell, Richard, Review: Peripheral-GameCube-G3 Wireless Controller, gamesarefun.com, Jul. 13, 2003 (accessed at http://www.gamesarefun.com/gamesdb/perireview.php?perireviewid=1 on Jul. 29, 2011).
Buchanan, Levi: "Happy Birthday, Rumble Pak," IGN.com, Apr. 3, 2008 (accessed at http://retro.ign.com/articles/864/864231p1.html on Jul. 29, 2011).
Buxton et al., "A Study in Two-Handed Input," Proceedings of CHI '86, pp. 321-326 (1986) (accessed at http://www.billbuxton.com/2hands.html on Jul. 29, 2011).
Buxton, Bill, "Human input/output devices," in M. Katz (ed.), *Technology Forecast: 1995*, Menlo Park, CA: Price Waterhouse World Firm Technology Center, pp. 49-65 (1994).
Buxton, Bill, A Directory of Sources for Input Technologies (last updated Apr. 19, 2001), http://web.archive.org/web/20010604004849/http://www.billbuxton.com/InputSources.html (accessed on Sep. 8, 2011).
Canaday, "R67-26 The Lincoln Wand," IEEE Transactions on Electronic Computers, vol. EC-16, No, 2, p. 240 (Apr. 1967) (downloaded from IEEE Xplore on Jul. 7, 2010).
Caruso et al., "A New Perspective on Magnetic Field Sensing," Sensors Magazine, Dec. 1, 1998 (accessed at http://www.sensorsmag.com/sensors/electric-magnetic/a-new-perspective-magnetic-field-sensing-855 on Jun. 17, 2010).
Caruso et al., "Vehicle Detection and Compass Applications using AMR Magnetic Sensors", Paper presented at 1999 Sensors Expo in Baltimore, Maryland (May 1999), available at http://masters.donntu.edu.ua/2007/kita/gerus/library/amr.pdf.
Caruso, "Application of Magnetoresistive Sensors in Navigation Systems," Sensors and Actuators, SAE SP-1220, pp. 15-21 (Feb. 1997); text of article accessed at http://www.ssec.honeywell.com/position-sensors/datasheets/sae.pdf.
Caruso, "Applications of Magnetic Sensors for Low Cost Compass Systems," Honeywell, SSEC, Paper presented at IEEE 2000 Position Location and Navigation Symposium (2000), accessed at http://www.ssec.honeywell.com/magnetic/datasheets/lowcost.pdf.
Cheng, "Direct interaction with Large-Scale Display Systems using Infrared Laser Tracking Devices," Paper presented at Australasian Symposium on Information Visualisation, Adelaide, Australia (2003).
Cheok et al., "Micro-Accelerometer Based Hardware Interfaces for Wearable Computer Mixed Reality Applications," 6th International Symposium on Wearable Computers (ISWC'02), 8 pages.
Cho et al., "*Magic Wand*: A Hand-Drawn Gesture Input Device in 3-D Space with Inertial Sensors," Proceedings of the 9th Intl Workshop on Frontiers in Handwriting Recognition (IWFHR-9 2004), IEEE (2004).
Clark, James H. "Designing Surfaces in 3-D," Graphics and Image Processing-Communications of the ACM, Aug. 1976; vol. 19; No. 8; pp. 454-460.
Clark, James H. "Three Dimensional Man Machine Interaction," Siggraph Jul. 14-16, 1976 Philadelphia, Pennsylvania, 1 page.
Colella, Vanessa et al., "Participatory Simulations: Using Computational Objects to Learn about Dynamic Systems," Chi 98; Apr. 1998, pp. 9-10.
Cooke, et al., "NPSNET: Flight simulation dynamic modeling using quaternions," Presence, vol. 1, No. 4, pp. 404-420, (Jan. 25, 1994).
Crecente, Brian, "Motion Gaming Gains Momentum," kotaku.com, Sep. 17, 2010 (accessed at http://kotaku.com/5640867/motion-gaming-gains-momentum on Aug. 31, 2011).
Cutrone, "Hot products: Gyration GyroPoint Desk, GyroPoint Pro gyroscope-controlled wired and wireless mice," Results from the Comdex Show Floor, Computer Reseller News, Dec. 4, 1995 (accessed from LexisNexis research database on Feb. 17, 2011; see pp. 8 and 9 of reference submitted herewith).
Deering, Michael F. "HoloSketch a Virtual Reality Sketching Animation Tool," ACM Transactions on Computer-Human Interaction, Sep. 1995; vol. 2, No. 3; pp. 220-238.
Deruyck, et al., "An Electromagnetic Position Sensor," Polhemus Navigation Sciences, Inc., Burlington, VT (Nov. 1973) (Abstract from DTIC Online).
Dichtburn, "Camera in Direct3D" Toymaker (Feb. 6, 2005), http://web.archive.org/web/20050206032104/http:/toymaker.info/games/html/camera.html (accessed on Jul. 29, 2011).
Donelson, et al., "Spatial Management of Information", Proceedings of 1978 ACM SIGGRAPH Conference in Atlanta, Georgia, pp. 203-209 (1978).
Druin, Allison et al., "Robots for Kids: Exploring New Technologies for Learning," Academic Press, 2000; Chap. 1, 27 pages.
Drzymala, Robert E. et al. "A Feasibility Study Using a Stereo-Optical Camera System to Verify Gamma Knife Treatment Specification," Proceedings of 22nd Annual EMBS International Conference, Jul. 2000; pp. 1486-1489.
Durlach, et al., "Virtual Reality: Scientific and Technological Challenges," National Academy Press (1995).

(56) **References Cited**

OTHER PUBLICATIONS

Emura, et al., "Sensor Fusion based Measurement of Human Head Motion," 3rd IEEE International Workshop on Robot and Human Communication (1994).
Ewalt, David M., "Nintendo's Wii is a Revolution," Review, Forbes.com, Nov. 13, 2006 (accessed at http://www.forbes.com/2006/11/13/wii-review-ps3-tech-media-cx_de_1113wii.html on Jul. 29, 2011).
Exintaris, et al., "Ollivander's Magic Wands : HCI Development," available at http://www.cim.mcgill.ca/~jer/courses/hci/project/2002/www.ece.mcgill.ca/%257Eeurydice/hci/notebook/final/MagicWand.pdf (2002).
Fielder, Lauren "E3 2001: Nintendo unleashes GameCube software, a new Miyamoto game, and more," GameSpot, May 16, 2001 (accessed at http://www.gamespot.com/news/2761390/e3-2001-nintendo-unleashes-gamecube-software-a-new-miyamoto-game-and-more?tag=gallery_summary%3Bstory on Jul. 29, 2011).
Foremski, T., "Remote Control Mouse Aims at Interactive TV" Electronics Weekly, Mar. 9, 1994.
Foxlin et al., "An Inertial Head-Orientation Tracker with Automatic Drift Compensation for Use with HMD's," Proceedings of the 1994 Virtual Reality Software and Technology Conference, Aug. 23-26, 1994, Singapore, pp. 159-173 (1994).
Foxlin et al., "Miniature 6-DOF Inertial System for Tracking HMDs," SPIE vol. 3362, Helmet and Head-Mounted Displays III, AeroSense 98, Orlando, FL, Apr. 13-14, 1998.
Foxlin et al., "WearTrack: A Self-Referenced Head and Hand Tracker for Wearable Computers and Portable VR," Proceedings of International Symposium on Wearable Computers (ISWC 2000), Oct. 16-18, 2000, Atlanta, GA (2000).
Foxlin et al., "FlightTracker: A Novel Optical/Inertial Tracker for Cockpit Enhanced Vision, Symposium on Mixed and Augmented Reality," Proceedings of the 3rd IEEE/ACM International Symposium on Mixed and Augmented Reality (ISMAR 2004), Nov. 2-5, 2004, Washington, D.C.
Foxlin, "Head-tracking Relative to a Moving Vehicle or Simulator Platform Using Differential Inertial Sensors," Proceedings of Helmet and Head-Mounted Displays V, SPIE vol. 4021, AeroSense Symposium, Orlando, FL, Apr. 24-25, 2000.
Foxlin, "Inertial Head Tracker Sensor Fusion by a Complementary Separate-bias Kalman Filter," Proceedings of the IEEE 1996 Virtual Reality Annual International Symposium, pp. 185-194, 267 (1996).
Foxlin, "Generalized architecture for simultaneous localization, auto-calibration, and map-building," IEEE/RSJ Conf. on Intelligent Robots and Systems (IROS 2002), Oct. 2-4, 2002, Lausanne, Switzerland (2002).
Foxlin, "Motion Tracking Requirements and Technologies," Chapter 7, from Handbook of Virtual Environment Technology, Kay Stanney, Ed., Lawrence Erlbaum Associates (2002) (extended draft version available for download at http://www.intersense.com/pages/44/119/).
Foxlin, "Pedestrian Tracking with Shoe-Mounted Inertial Sensors," IEEE Computer Graphics and Applications, vol. 25, No. 6, pp. 38-46, (2005).
Foxlin, et al., "Constellation™: A Wide-Range Wireless Motion-Tracking System for Augmented Reality and Virtual Set Applications," ACM SIGGRAPH 98, Orlando, Florida, Jul. 19-24, 1998.
Foxlin, et al., "Miniaturization, Calibration & Accuracy Evaluation of a Hybrid Self-Tracker," IEEE/ACM International Symposium on Mixed and Augmented Reality (ISMAR 2003), Oct. 7-10, 2003, Tokyo, Japan.
Foxlin, et al., "VIS-Tracker: A Wearable Vision-Inertial Self-Tracker," IEEE VR2003, Mar. 22-26, 2003, Los Angeles, CA.
Frankle, "E3 2002: Roll O Rama," Roll-o-Rama GameCube Preview at IGN, May 23, 2002 (accessed at http://cube.ign.com/articles/360/360662p1.html on Sep. 7, 2011).
Friedmann, et al., "Device Synchronization Using an Optimal Linear Filter," SI3D '92: Proceedings of the 1992 symposium on Interactive 3D graphics, pp. 57-62 (1992).
Friedmann, et al., "Synchronization in virtual realities," M.I.T. Media Lab Vision and Modeling Group Technical Report No. 157, Jan. 1991 to appear in Presence, vol. 1, No. 1, MIT Press, Cambridge, MA (1991).
Fuchs, Eric, "Inertial Head-Tracking," MS Thesis, Massachusetts Institute of Technology, Dept. of Electrical Engineering and Computer Science (Sep. 1993).
Furniss, Maureen, "Motion Capture," posted at http://web.mit.edu/m-i-t/articles/index_furniss.html on Dec. 19, 1999; paper presented at the Media in Transition Conference at MIT on Oct. 8, 1999 (accessed on Sep. 8, 2011).
Geen et al., "New iMEMS® Angular-Rate-Sensing Gyroscope," Analog Dialogue 37-03, pp. 1-3 (2003).
Gelmis, J., "Ready to Play, The Future Way," Buffalo News, Jul. 23, 1996 (accessed from LexisNexis research database on Sep. 6, 2011).
Green, Jonathan et al., "Camping in the Digital Wilderness: Tents and Flashlights As Interfaces to Virtual Worlds," Chi 2002, Apr. 2002, pp. 780-781.
Grimm, et al., "Real-Time Hybrid Pose Estimation from Vision and Inertial Data," Proceedings of the First Canadian Conference on Computer and Robot Vision (CRV'04), IEEE Computer Society (2004).
Harada et al., "Portable Absolute Orientation Estimation Device with Wireless Network Under Accelerated Situation" Proceedings of the 2004 IEEE International Conference on Robotics & Automation, New Orleans, LA, Apr. 2004, pp. 1412-1417(2004).
Harada et al., "Portable orientation estimation device based on accelerometers, magnetometers and gyroscope sensors for sensor network," Proceedings of IEEE International Conference on Multisensor Fusion and Integration for Intelligent Systems (MFI 2003), pp. 191-196, (2003).
Haykin, et al., "Adaptive Tracking of Linear Time-Variant Systems by Extended RLS Algorithms, IEEE Transactions on Signal Processing," vol. 45, No. 5, pp. 1118-1128 (May 1997).
Heath, "Virtual Reality Resource Guide AI Expert," v9 n5 p32(14) (May 1994) (accessed at http://ftp.hitl.washington.edu/scivw-ftp/commercial/VR-Resource-Guide.txt on Jun. 17, 2010).
Hinckley, "Synchronous Gestures for Multiple Persons and Computers," Paper presented at ACM UIST 2003 Symposium on User Interface Software & Technology in Vancouver, BC, Canada (Nov. 2003).
Hinckley, et al., "A Survey of Design Issues in Spatial Input," Paper presented at 7th Annual ACM Symposium on User Interface Software and Technology (1994).
Hinckley, et al., "Sensing Techniques for Mobile Interaction," Proceedings of the 13th Annual ACM Symposium on User Interface Software and Technology (ACM UIST), San Diego, CA, (2000).
Hinckley, et al., "The VideoMouse: A Camera-Based Multi-Degree-of-Freedom Input Device" ACM UIST'99 Symposium on User Interface Software & Technology, CHI Letters vol. 1 No. 1, pp. 103-112 (1999).
Hinckley, Ken "Haptic Issues for Virtual Manipulation," Ph.D. Dissertation University of Virginia, Dept. of Computer Science (1997).
Hind, Nicholas, "Cosmos: A composition for Live Electronic Instruments Controlled by the Radio Baton and Computer Keyboard (Radio Baton and Magic Glove)," A Final Project Submitted to the Department of Music of Stanford University in Partial Fulfillment of the Requirements for the Degree of Doctor Musical Arts/UMI Microform 9837187, Jan. 1998.
Holden, Maureen K. et al., "Use of Virtual Environments in Motor Learning and Rehabilitation," Department of Brain and Cognitive Sciences, Handbook of Virtual Environments: Design, Implementation, and Applications, Chap. 49, pp. 999-1026, Stanney (ed), Lawrence Erlbaum Associates (2002).
Holloway, Richard Lee, "Registration Errors in Augmented Reality Systems," Ph.D. Dissertation, University of North Carolina at Chapel Hill, Dept. of Computer Science (1995).
Hoffman, Hunter G. "Physically Touching Virtual Objects Using Tactile Augmentation Enhances the Realism of Virtual Environments," IEEE Virtual Reality Annual International Symposium '98, Atlanta, Georgia, 1998, 5 pages.
Jacob, "Human-Computer Interaction—Input Devices," ACM Computing Surveys, vol. 28, No. 1, pp. 177-179 (Mar. 1996); link to text of article provided at http://www.cs.tufts.edu/~jacob/papers/.

(56) **References Cited**

OTHER PUBLICATIONS

Jakubowsk, et al., "Increasing Effectiveness of Human Hand Tremor Separation Process by Using Higher-Order Statistics," Measurement Science Review, vol. 1, No. 1 (2001).
Ji, H. "Study on the Infrared Remote-Control Lamp-Gesture Device," Yingyong Jiguang/Applied Laser Technology, v. 17, n. 5, p. 225-227, Language: Chinese-Abstract only, Oct. 1997.
Jiang, "Capacitive position-sensing interface for micromachined inertial sensors," Dissertation at Univ. of Cal. Berkeley, 2003.
Ju, et al., "The Challenges of Designing a User Interface for Consumer Interactive Television Consumer Electronics Digest of Technical Papers.," IEEE 1994 International Conference on Volume , Issue , Jun. 21-23, 1994 pp. 114-115 (Jun. 1994) (downloaded from IEEE Xplore on Jul. 13, 2010).
Keir et al., "Gesture-recognition with Nonreferenced Tracking," IEEE Symposium on 3D User Interfaces, pp. 151-158, Mar. 25-26, 2006.
Kennedy, P.J. "Hand-held Data Input Device," IBM Technical Disclosure Bulletin, vol. 26, No. 11, pp. 5826-5827, Apr. 1984.
Kessler, et al., "The Simple Virtual Environment Library: an Extensible Framework for Building VE Applications," Presence, MIT Press (2000).
Kindratenko, "A Comparison of the Accuracy of an Electromagnetic and a Hybrid Ultrasound-Inertia Position Tracking System," MIT Presence, vol. 10, No. 6, pp. 657-663, Dec. 2001.
Klein et al., "Tightly Integrated Sensor Fusion for Robust Visual Tracking," British Machine Vision Computing, vol. 22, No. 10, pp. 769-776, 2004.
Kohlhase, "NASA Report, The Voyager Neptune travel guide," Jet Propulsion Laboratory Publication 89-24, (Jun. 1989).
Kormos, D.W. et al., "Intraoperative, Real-Time 3-D Digitizer for Neurosurgical Treatment and Planning," 1993; 1 page.
Kormos, D.W., et al., "Intraoperative, Real-Time 3-D Digitizer for Neurosurgical Treatment and Planning," IEEE (1993) (Abstract only).
Kosak, Dave, "Mind-Numbing New Interface Technologies," Gamespy.com, Feb. 1, 2005 (accessed at http://www.gamespy.com/articles/584/584744p1.html on Aug. 31, 2011).
Krumm et al., "How a Smart Environment can Use Perception," Paper presented at UBICOMP 2001 Workshop on Perception for Ubiquitous Computing (2001).
Kuipers, Jack B., "SPASYN—An Electromagnetic Relative Position and Orientation Tracking System," IEEE Transactions on Instrumentation and Measurement, vol. 29, No. 4, pp. 462-466 (Dec. 1980).
Kunz, Andreas M. et al., "Design and Construction of a New Haptic Interface," Proceedings of DETC '00, ASME 2000 Design Engineering Technical Conferences and Computers and Information in Engineering Conference, Baltimore, Maryland, Sep. 10-13, 2000.
La Scala, et al., "Design of an Extended Kalman Filter Frequency Tracker," IEEE Transactions on Signal Processing, vol. 44, No. 3 (Mar. 1996).
Laughlin et al., "Inertial Angular Rate Sensors: Theory and Applications," Sensors Magazine Oct. 1992.
Lee et al, "Tilta-Pointer: the Free-Space Pointing Device," Princeton COS 436 Project (Fall 2004); retrieved from Google's cache of http://www.milyehuang.com/cos436/project/specs.html on May 27, 2011.
Lee et al., "Innovative Estimation Method with Measurement Likelihood for all-Accelerometer Type Inertial Navigation System," IEEE Transactions on Aerospace and Electronic Systems, vol. 38, No. 1, Jan. 2002.
Lee et al., "Two-Dimensional Position Detection System with MEMS Accelerometer for Mouse Applications," Design Automation Conference, 2001, Proceedings, 2001 pp. 852-857, Jun. 2001.
Leganchuk et al., "Manual and Cognitive Benefits of Two-Handed Input: An Experimental Study," ACM Transactions on Computer-Human Interaction, vol. 5, No. 4, pp. 326-259, Dec. 1998.
Liang, et al., "On Temporal-Spatial Realism in the Virtual Reality Environment," ACM 1991 Symposium on User Interface Software and Technology (Nov. 1991).
Link, "Field-Qualified Silicon Accelerometers from 1 Milli g to 200,000 g," Sensors, Mar. 1993.
Liu, et al., "Enhanced Fisher Linear Discriminant Models for Face Recognition," Paper presented at 14^{th} International Conference on Pattern Recognition (ICPR'98), Queensland, Australia (Aug. 1998).
Lobo et al., "Vision and Inertial Sensor Cooperation Using Gravity as a Vertical Reference," IEEE Trans. on Pattern Analysis and Machine Intelligence, vol. 25, No. 12, pp. 1597-1608, Dec. 2003.
Louderback, J. "Nintendo Wii", Reviews by PC Magazine, Nov. 13, 2006 (accessed at http://www.pcmag.com/article/print/193909 on Sep. 8, 2011).
Luethi, P. et al., "Low Cost Inertial Navigation System" (2000); downloaded from http://www.electronic-engineering.ch/study/ins/ins.html on Jun. 18, 2010.
Luinge, "Inertial sensing of human movement," Thesis, University of Twente, Twente University Press, 2002.
Luinge, et al., "Estimation of orientation with gyroscopes and accelerometers," Proceedings of the First Joint BMES/EMBS Conference, 1999., vol. 2, p. 844 (Oct. 1999).
Mackenzie et al., "A two-ball mouse affords three degrees of freedom," Extended Abstracts of the CHI '97 Conference on Human Factors in Computing Systems, pp. 303-304. New York: ACM (1997).
Mackinlay, "Rapid Controlled Movement Through a Virtual 3D Workspace," ACM SIGGRAPH Computer Graphics archive, vol. 24, No. 4, pp. 171-176 (Aug. 1990).
Maclean, "Designing with Haptic Feedback", Paper presented at IEEE Robotics and Automation (ICRA '2000) Conference in San Francisco, CA, Apr. 22-28, 2000.
Maggioni, C., "A novel gestural input device for virtual reality," IEEE Virtual Reality Annual International Symposium (Cat. No. 93CH3336-5), 118-24, 1993.
Marks, Richard. (Jan. 21, 2004) (Windows Media v7). EyeToy: A New Interface for Interactive Entertainment, Stanford University (accessed at http://lang.stanford.edu/courses/ee380/2003-2004/040121-ee380-100.wmv on Sep. 7, 2011; digital video available upon request).
Marrin, "Possibilities for the Digital Baton as a General Purpose Gestural Interface," Late-Breaking/Short Talks, Paper presented at CHI 97 Conference in Atlanta Georgia, Mar. 22-27, 1997 (accessed at http://www.sigchi.org/chi97/proceedings/short-talk/tm.htm on Aug. 5, 2011).
Marrin, Teresa et al., "The Digital Baton: A Versatile Performance Instrument," Paper presented at International Computer Music Conference, Thessaloniki, Greece (1997) (text of paper available at http://quod.lib.umich.edu/cgi/p/pod/dod-idx?c=icmc;idno=bbp2372.1997.083).
Marrin, Teresa, "Toward an Understanding of Musical Gesture: Mapping Expressive Intention with the Digital Baton," Masters Thesis, Massachusetts Institute of Technology, Program in Media Arts and Sciences (1996).
Marti et al., "Biopsy navigator: a smart haptic interface for interventional radiological gestures" Proceedings of the Computer Assisted Radiology and Surgery (CARS 2003) Conference, International Congress Series, vol. 1256, pp. 788-793 (2003) (text of paper available at http://infoscience.epfl.ch/record/29966/files/CARS03-GM.pdf).
Masliah, "Measuring the Allocation of Control in 6 Degree of Freedom Docking Experiment," Paper presented at SIGCHI Conference on Human Factors in Computing Systems, The Hague, Netherlands (2000).
Maybeck, "Stochastic Models, Estimation and Control," vol. 1, Chapter 1, Introduction (1979).
Merians, et al., "Virtual Reality-Augmented Rehabilitation for Patients Following Stroke," Physical Therapy, vol. 82, No. 9, Sep. 2002.
Merrill, "FlexiGesture: A sensor-rich real-time adaptive gesture and affordance learning platform for electronic music control," Thesis, Massachusetts Institute of Technology, Jun. 2004.
Meyer et al., "A Survey of Position Tracker," MIT Presence, vol. 1, No. 2, pp. 173-200, (1992).

(56) **References Cited**

OTHER PUBLICATIONS

Miller, Paul, "Exclusive shots of Goschy's prototype 'Wiimote' controllers," Engadget, Jan. 15, 2008 (accessed at http://www.engadget.com/2008/01/15/exclusive-shots-of-goschys-prototype-wiimote-controllers/ on Aug. 31, 2011).
Miller, Ross, "Joystiq interview: Patrick Goschy talks about Midway, tells us he 'made the Wii'," Joystiq.com, Jan. 16, 2008 (accessed at http://www.joystiq.com/2008/01/16/joystiq-interview-patrick-goschy-talks-about-midway-tells-us-h/ on Aug. 31, 2011).
Mizell, "Using Gravity to Estimate Accelerometer Orientation," Proceedings of the Seventh IEEE International Symposium on Wearable Computers (ISWC '03), IEEE Computer Society (2003).
Morgan, C., "Still chained to the overhead projector instead of the podium," (TV Interactive Corp's LaserMouse Remote Pro infrared mouse) (clipboard) (brief article) (product announcement) Government Computer News, Jun. 13, 1994.
Morris, "Accelerometry—a technique for the measurement of human body movements," J Biomechanics vol. 6, pp. 729-736 (1973).
Moser, "Low Budget Inertial Navigation Platform (2000)," www.tmoser.ch/typo3/11.0.html (accessed on Jul. 29, 2011).
Mulder, "Human movement tracking technology," Technical Report, NSERC Hand Centered Studies of Human Movement project, available through anonymous ftp in fas.sfu.ca:/pub/cs/graphics/vmi/HMTT.pub.ps.Z., Burnab, B.C, Canada: Simon Fraser University (Jul. 1994).
Myers et al., "Interacting at a Distance: Measuring the Performance of Laser Pointers and Other Devices," CHI 2002, Apr. 2002.
Naimark et al., "Circular Data Matrix Fiducial System and Robust Image Processing for a Wearable Vision-Inertial Self-Tracker," IEEE International Symposium on Mixed and Augmented Reality (ISMAR 2002), Darmstadt, Germany (2002).
Naimark, et al., "Encoded LED System for Optical Trackers," Paper presented at Fourth IEEE and ACM International Symposium on Mixed and Augmented Reality (ISMAR 2005), Oct. 5-8, 2005, Vienna Austria (2005) (electronic version of text of paper available for download at http://www.intersense.com/pages/44/129/.
Navarrete, et al., "Eigenspace-based Recognition of Faces: Comparisons and a new Approach," Paper Presented at 11th International Conference on Image Analysis and Processing (2001).
Nishiyama, "A Nonlinear Filter for Estimating a Sinusoidal Signal and its Parameters in White Noise: On the Case of a Single Sinusoid," IEEE Transactions on Signal Processing, vol. 45, No, 4, pp. 970-981 (Apr. 1997).
Nishiyama, "Robust Estimation of a Single Complex Sinusoid in White Noise-H∞ Filtering Approach," IEEE Transactions on Signal Processing, vol. 47, No. 10, pp. 2853-2856 (Oct. 1999).
Odell, "An Optical Pointer for Infrared Remote Controllers," (1995) (downloaded from IEEE Xplore on Jul. 7, 2010).
Ojeda, et al., "No GPS? No Problem!" University of Michigan Develops Award-Winning Personal Dead-Reckoning (PDR) System for Walking Users, available at http://www.engine.umich.edu/research/mrl/urpr/In_Press/P135.pdf, (2004 or later).
Omelyan, "On the numerical integration of motion for rigid polyatomics: The modified quaternion approach" Computers in Physics, vol. 12 No. 1, pp. 97-103 (1998).
Ovaska, "Angular Acceleration Measurement: A Review," Paper presented at IEEE Instrumentation and Measurement Technology Conference, St. Paul, MN, May 18-21, 1998.
Pai, et al., "The Tango: A Tangible Tangoreceptive Whole-Hand Interface," Paper presented at Joint Eurohaptics and IEEE Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems, Pisa, Italy, Mar. 18-20, 2005.
Paley, W. Bradford, "Interaction in 3D Graphics," SIGGRAPH Computer Graphics Newsletter, col. 32, No. 4 (Nov. 1998) (accessed at http://www.siggraph.org/publications/newsletter/v32n4/contributions/paley.html on Aug. 2, 2011).
Paradiso, et al., "Interactive Therapy with Instrumented Footwear," CHI 2004, Apr. 24-29, 2004, Vienna, Austria.
Paradiso, et al., "Musical Applications of Electric Field Sensing", available at http://pubs.media.mit.edu/pubs/papers/96_04_cmj.pdf (1996).
Paradiso, Joseph A., "The Brain Opera Technology: New Instruments and Gestural Sensors for Musical Interaction and Performance" (Nov. 1998) (available at http://pubs.media.mit.edu/pubs/papers/98_3_JNMR_Brain_Opera.pdf).
Park, Adaptive control strategies for MEMS gyroscopes (Dissertation), Univ. Cal. Berkley (Dec. 2000).
Perry, Simon, "Nintendo to Launch Wireless Game Boy Adaptor," Digital Lifestyles, http://digital-lifestyles.info/2003/09/26/Nintendo-to-launch-wireless-game-boy-adaptor/, Sep. 26, 2003 (accessed on Jul. 29, 2011).
Phillips, "Forward/Up Directional Incompatibilities During Cursor Placement Within Graphical User Interfaces," Ergonomics, vol. 48, No. 6, May 15, 2005.
Phillips, "LPC2104/2105/2106, Single-chip 32-bit microcontrollers; 128 kB ISP/IAP Flash with 64 kB/32 kB/16 kB RAM," Dec. 22, 2004.
Phillips, "Techwatch: On the Right Track: A unique optical tracking system gives users greater freedom to explore virtual worlds," Computer Graphics World, vol. 23, Issue 4 (Apr. 2000).
Pierce et al., "Image Plane Interaction Techniques in 3D Immersive Environments," Paper presented at 1997 symposium on Interactive 3D graphics, Providence, RI (1997).
Pilcher, "AirMouse Remote Controls," IEEE Conference on Consumer Electronics (1992).
Pique, "Semantics of Interactive Rotations," Interactive 3D Graphics, Proceedings of the 1986 workshop on Interactive 3D graphics, pp. 259-269 (Oct. 1986).
Piyabongkarn, "The Development of a MEMS Gyroscope for Absolute Angle Measurement," Dissertation, Univ. Minnesota, Nov. 2004 (Abstract only).
Pryor et al., "A Reusable Software Architecture for Manual Controller Integration," IEEE Conf. on Robotics and Automation, Univ of Texas, pp. 3583-3588 (Apr. 1997).
Raab, et al., "Magnetic Position and Orientation Tracking System," IEEE Transactions on Aerospace and Electronic Systems, vol. AES-15, No. 5, pp. 709-718 (Sep. 1979).
Regan, "Smart Golf Clubs," baltimoresun.com, Jun. 17, 2005.
Rekimoto, "Tilting Operations for Small Screen Interfaces," Tech Note presented at 9th Annual ACM Symposium on User Interface Software and Technology (UIST'96) (1996) (available for download at http://www.sonycsl.co.jp/person/rekimoto/papers/uist96.pdf.
Resnick, Mitchel et al., "Digital Manipulatives: New Toys to Think With," Chi 98; Apr. 1998; pp. 281-287.
Reunert, "Fiber-Optic Gyroscopes: Principles and Applications," Sensors, Aug. 1993, pp. 37-38.
Ribo, et al., "Hybrid Tracking for Outdoor Augmented Reality Applications," IEEE Computer Graphics and Applications, vol. 22, No. 6, pp. 54-63, Nov./Dec. 2002.
Riviere, et al., "Adaptive Canceling of Physiological Tremor for Improved Precision in Microsurgery," IEEE Transactions on Biomedical Engineering, vol. 45, No. 7, pp. 839-846 (Jul. 1998).
Roberts, "The Lincoln Wand," 1966 Proceedings of the Fall Joint Computer Conference (1966), available for electronic download at http://www.computer.org/portal/web/csdl/doi/10.1109/AFIPS.1966.105.
Robinett et al., "Implementation of Flying, Scaling, and Grabbing in Virtual Worlds," ACM Symposium (1992).
Robinett et al., "The Visual Display Transformation for Virtual Reality," University of North Carolina at Chapel Hill (1994).
Roetenberg, "Inertial and magnetic sensing of human motion," Thesis, University of Twente (2006).
Roetenberg, et al., "Inertial and Magnetic Sensing of Human Movement Near Ferromagnetic Materials," Paper presented at Second IEEE and ACM International Symposium on Mixed and Augmented Reality, Mar. 2003 (available at http://www.xsens.com/images/stories/PDF/Inertial%20and%20magnetic%20sensing%20of%20human %20movement%20near%20ferromagnetic%20materials.pdf.

(56) **References Cited**

OTHER PUBLICATIONS

Rolland, et al., "A Survey of Tracking Technology for Virtual Environments," University of Central Florida, Center for Research and Education in Optics Lasers (CREOL) (2001).
Romer, Kay et al., "Smart Playing Cards: A Ubiquitous Computing Game," Personal and Ubiquitous Computing, vol. 6, Issue No. 5-6, pp. 371-377, London, England (Dec. 2002).
Rothman, Wilson, "Unearthed: Nintendo's Pre-Wiimote Prototype," gizmodo.com, Aug. 29, 2007 (accessed at http://gizmodo.com/gadgets/exclusive/unearthed-nintendo-2001-prototype-motion+sensing-one+handed-controller-by-gyration-294642.php on Aug. 31, 2011).
Rothman, Wilson, "Wii-mote Prototype Designer Speaks Out, Shares Sketchbook," Gizmodo.com, Aug. 30, 2007 (accessed at http://gizmodo.com/gadgets/exclusive/wii+mote-prototype-designer-speaks-out-shares-sketchbook-295276.php on Aug. 31, 2011).
Sakai, et al., "Optical Spatial Filter Sensor for Ground Speed," Optical Review, vol. 2, No. 1, pp. 65-67 (1995).
Santiago, "Extended Kalman filtering applied to a full accelerometer strapdown inertial measurement unit," M.S. Thesis, Massachusetts Institute of Technology, Dept. Of Aeronautics and Astronautics, Santiago (1992).
Satterfield, Shane, "E3 2002: Nintendo announces new GameCube games," GameSpot, http://www.gamespot.com/gamecube/action/rollorama/news/2866974/e3-2002-nintendo-announces-new-gamecube-games, May 21, 2002 (accessed on Aug. 11, 2011).
Sawada, et al., "A Wearable Attitude-Measurement System Using a Fiberoptic Gyroscope," MIT Presence, vol. 11, No. 2, pp. 109-118, Apr. 2002.
Saxena, et al., "In Use Parameter Estimation of Inertial Sensors by Detecting Multilevel Quasi-Static States," Berlin: Springer-Verlag, pp. 595-601 (2005).
Sayed, "A Framework for State-Space Estimation with Uncertain Models," IEEE Transactions on Automatic Control, vol. 46, No. 7, Jul. 2001.
Schofield, Jack et al., Games reviews, "Coming up for airpad," The Guardian (Feb. 3, 2000) (accessed at http://www.guardian.co.uk/technology/2000/feb/03/online supplement5/print on Jun. 18, 2010).
Shoemake, Ken, "Quaternions," available online at http://campar.in.tum.de/twikl/pub/Chair/DwarfTutorial/quatut.pdf.
Skiens, Mike, "Nintendo Announces Wireless GBA Link", Bloomberg, Sep. 25, 2003 (accessed at http://www.nintendoworldreport.com/news/9011).
Sorenson, et al., "The Minnesota Scanner: A Prototype Sensor for Three-Dimensional Tracking of Moving Body Segments," IEEE Transactions on Robotics and Animation, vol. 5, No. 4 (Aug. 1989).
Stovall, "Basic Inertial Navigation," NAWCWPNS TM 8128, Navigation and Data Link Section, Systems Integration Branch (Sep. 1997).
Sulic, "Logitech Wingman Cordless Rumblepad Review," Gear Review at IGN, Jan. 14, 2002 (accessed at http://gear.ign.com/articles/317/317472p1.html on Aug. 1, 2011).
Sutherland, "A Head-Mounted Three Dimensional Display," Paper presented at AFIPS '68 Fall Joint Computer Conference, Dec. 9-11, 1968, (1968); paper available at www.cise.ufl.edu/~lok/teaching/dcvef05/papers/sutherland-headmount.pdf.
Sutherland, Ivan E., "Sketchpad: A Man-Machine Graphical Communication System," Proceedings of the AFIPS Spring Joint Computer Conference, Detroit, Michigan, May 21-23, 1963, pp. 329-346 (source provided is reprinting of text accessed at http://www.guidebookgallery.org/articles/sketchpadamanmachinegraphicalcommunicationsystem on Sep. 8, 2011).
Templeman, James N., "Virtual Locomotion: Walking in Place through Virtual Environments," Presence, vol. 8, No. 6, pp. 598-617, Dec. 1999.
Timmer, "Modeling Noisy Time Series: Physiological Tremor," International Journal of Bifurcation and Chaos, vol. 8, No. 7 (1998).
Timmer, et al, "Pathological Tremors: Deterministic Chaos or Nonlinear Stochastic Oscillators?" Chaos, vol. 10, No. 1 pp. 278-288 (Mar. 2000).
Timmer, et al., "Characteristics of Hand Tremor Time Series," Biological Cybernetics, vol. 70, No. 1, pp. 75-80 (1993).
Timmer, et al., "Cross-Spectral Analysis of Tremor Time Series," International Journal of Bifurcation and Chaos, vol. 10, No. 11 pp. 2595-2610 (2000); text available at http://www.fdmold.uni-freiburg.de/groups/timeseries/tremor/pubs/cs_review.pdf.
Timmer, et al., Cross-Spectral Analysis of Physiological Tremor and Muscle Activity: II Application to Synchronized Electromyogram, Biological Cybernetics, vol. 78 (1998) (obtained from http://arxiv.org/abs/chao-dyn/9805012).
Titterton et al., "Strapdown Inertial Navigation Technology," Peter Peregrinus Ltd., pp. 1-56 and pp. 292-321 (1997).
Ulanoff, Lance, "Nintendo's Wii is the Best Product Ever," PC Magazine, Jun. 21, 2007 (accessed at http://www.pcmag.com/print_article2/0,1217,a=210070,00.asp?hidPrint=true on Aug. 1, 2011).
Urban, "BAA 96-37 Proposer Information," DARPA/ETO (1996) (accessed at http://www.fbodaily.com/cbd/archive/1996/08(August)/19-Aug-1996/Aso1001.htm on Jul. 27, 2010).
Van Den Bogaard, Thesis, "Using linear filters for real-time smoothing of rotational data in virtual reality application," dated Aug. 2, 2004, available at http://www.science.uva.nl/research/ias/alumni/m.sc.theses/theses/RobvandenBogaarad.pdf.
Van Laerhoven et al., "Using an Autonomous Cube for Basic Navigation and Input," Proceedings of the 5th International Conference on Multimodal interfaces, Vancouver, British Columbia, Canada, pp. 203-210, Nov. 5-7, 2003.
Van Rheeden, et al., "Noise Effects on Centroid Tracker Aim Point Estimation," IEEE Trans. On Aerospace and Electronic Systems, vol. 24, No. 2, pp. 177-185 (Mar. 1988).
Vaz, et al., "An Adaptive Estimation of Periodic Signals Using a Fourier Linear Combiner," IEEE Transactions on Signal Processing, vol. 42, No. 1, pp. 1-10 (Jan. 1994).
Verplaetse, "Inertial Proprioceptive Devices: Self-Motion Sensing Toys and Tools," IBM Systems Journal, vol. 35, Nos. 3&4 (Sep. 1996).
Verplaetse, "Inertial-Optical Motion-Estimating Camera for Electronic Cinematography," Masters Thesis, MIT, Media Arts and Sciences (1997).
Villoria, Gerald, "Hands on Roll-O-Rama Game Cube," Game Spot, http://www.gamespot.com/gamecube/action/rollorama/news.html?sid=2868421&com_act=convert&om_clk=newsfeatures&tag=newsfeatures;title;1&m, May 29, 2002 (accessed on Jul. 29, 2011).
Vorozcovs et al., "The Hedgehog: A Novel Optical Tracking Method for Spatially Immersive Displays," MIT Presence, vol. 15, No. 1, pp. 108-121, Feb. 2006.
VTI, Mindflux-Vti CyberTouch, http://www.mindflux.com/au/products/vti/cybertouch.html (1996).
Wang, et al., "Tracking a Head-Mounted Display in a Room-Sized Environment with Head-Mounted Cameras," Paper presented at SPIE 1990 Technical Symposium on Optical Engineering and Photonics in Aerospace Sensing (1990).
Ward, et al., "A Demonstrated Optical Tracker With Scalable Work Area for Head-Mounted Display Systems," Paper presented at 1992 Symposium on Interactive 3D Graphics (1992).
Watt, Alan, 3D Computer Graphics, Chapter 1: "Mathematical fundamentals of computer graphics," 3rd ed. Addison-Wesley, pp. 1-26 (2000).
Welch et al., "Complementary Tracking and Two-Handed Interaction for Remote 3D Medical Consultation with a PDA," Paper presented at Trends and Issues in Tracking for Virtual Environments Workshop at IEEE Virtual Reality 2007 Conference (2007), available at http://www.cs.unc.edu/~welch/media/pdf/Welch2007_TwoHanded.pdf.
Welch et al., "Motion Tracking: No Silver Bullet, but a Respectable Arsenal," IEEE Computer Graphics and Applications, vol. 22, No. 6, pp. 24-38 (2002), available at http://www.cs.unc.edu/~tracker/media/pdf/cga02_welch_tracking.pdf.

(56) **References Cited**

OTHER PUBLICATIONS

Welch, "Hawkeye Zooms in on Mac Screens with Wireless Infrared Penlight Pointer," MacWeek, May 3, 1993 (excerpt of article accessed at http://www.accessmylibrary.com/article/print/1G1-13785387 on Jun. 18, 2010).
Welch, "Hybrid Self-Tracker: An Inertial/Optical Hybrid Three-Dimensional Tracking System," Tech Report TR95-048, Dissertation Proposal, Univ. Of North Carolina at Chapel Hill, Dept. Computer Science, Chapel Hill, N.C. (1995).
Welch, et al., "High-Performance Wide-Area Optical Tracking: *The HiBall Tracking System*," MIT Presence: Teleoperators & Virtual Environments (Feb. 2001).
Welch, et al., "SCAAT: Incremental Tracking with Incomplete Information," Paper presented at SIGGRAPH 97 Conference on Computer Graphics and Interactive Techniques (1997), available at http://www.cs.unc.edu/~welch/media/pdf/scaat.pdf.
Welch, et al., "The HiBall Tracker: High-Performance Wide-Area Tracking for Virtual and Augmented Environments," Paper presented at 1999 Symposium on Virtual Reality Software and Technology in London, Dec. 20-22, 1999, available at http://www.cs.unc.edu/~welch/media/pdf/VRST99_HiBall.pdf.
Widrow, et al., "Fundamental Relations Between the LMS Algorithm and the DFT," IEEE Transactions on Circuits and Systems, vol. CAS-34, No. 7 (Jul. 1987).
Wiley, M., "Nintendo Wavebird Review," Jun. 11, 2002, http://gear.ign.com/articles/361/361933p1.html (accessed on Aug. 1, 2011).
Williams et al., "Implementation and Evaluation of a Haptic Playback System," vol. 3, No. 3, Haptics-e, 2004.
Williams et al., "The Virtual Haptic Back Project," presented at the Image 2003 Conference, Scottsdale, Arizona, Jul. 14-18, 2003.
Williams et al., "Physical Presence: Palettes in Virtual Spaces," Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series, vol. 3639, No. 374-384 (May 1999), available at http://www.fakespacelabs.com/papers/3639_46_LOCAL.pdf.
Wilson "WorldCursor: Pointing in Intelligent Environments with the World Cursor," http://www.acm.org/uist/archive/adjunct/2003/pdf/demos/d4-wilson.pdf (2003).
Wilson et al., "Demonstration of the Xwand Interface for Intelligent Spaces," UIST '02 Companion, pp. 37-38 (2002).
Wilson et al., "Gesture Recognition Using the Xwand," http://www.ri.cmu.edu/pub_files/pub4/wilson_daniel_h_2004_1/wilson_daniel_h_2004_1.pdf (2004).
Wilson et al., "Xwand: UI for Intelligent Spaces," Paper presented at CHI 2003 Conference, Ft. Lauderdale, FL, Apr. 5-10, 2003, available at http://research.microsoft.com/en-us/um/people/awilson/publications/WilsonCHI2003/CHI%202003%20XWand.pdf (2003).
Wilson, "Wireless User Interface Devices for Connected Intelligent Environments," http://research.microsoft.com/en-us/um/people/awilson/publications/old/ubicomp%202003.pdf (2003).
Wormell et al., "Advancements in 3D Interactive Devices for Virtual Environments," Presented at the Joint International Immersive Projection Technologies (IPT)/Eurographics Workshop on Virtual Environments (EGVE) 2003 Workshop, Zurich, Switzerland, May 22-23, 2003 (available for download at http://www.intersense.com/pages/44/123/) (2003).
Wormell, "Unified Camera, Content and Talent Tracking in Digital Television and Movie Production," Presented at NAB 2000, Las Vegas, NV, Apr. 8-13, 2000 (available for download at http://www.intersense.com/pp./44/116/) (2003).
Worringham, et al., "Directional Stimulus-Response Compatibility: A Test of Three Alternative Principles," Ergonomics, vol. 41, Issue 6, pp. 864-880 (Jun. 1998).
Yang et al., "Implementation and Evaluation of 'Just Follow Me': An Immersive, VR-Based, Motion-Training System," MIT Presence: Teleoperators and Virtual Environments, vol. 11, No. 3, at 304-23 (MIT Press), Jun. 2002.
You et al., "Hybrid Inertial and Vision Tracking for Augmented Reality Registration," http://graphics.usc.edu/cgit/pdf/papers/Vr1999.PDF (1999).
You et al., "Orientation Tracking for Outdoor Augmented Reality Registration," IEEE Computer Graphics and Applications, IEEE, vol. 19, No. 6, pp. 36-42 (Nov. 1999).
Youngblut, et al., "Review of Virtual Environment Interface Technology," Institute for Defense Analyses (Mar. 1996).
Yun et al., "Recent Developments in Silicon Microaccelerometers," Sensors, 9(10) University of California at Berkeley, Oct. 1992.
Zhai, "Human Performance in Six Degree of Freedom Input Control," Ph.D. Thesis, University of Toronto (1995).
Zhai, "User Performance in Relation to 3D Input Device Design," Computer Graphics 32(4), pp. 50-54, Nov. 1998; text downloaded from http://www.almaden.ibm.com/u/zhai/papers/siggraph/final.html on Aug. 1, 2011.
Zhou et al., "A survey—Human Movement Tracking and Stroke Rehabilitation," Technical Report: CSM-420, ISSN 1744-8050, Dept. of Computer Sciences, University of Essex, UK, Dec. 8, 2004.
Zhu et al., "A Real-Time Articulated Human Motion Tracking Using Tri-Axis Inertial/Magnetic Sensors Package," IEEE Transactions on Neural Systems and Rehabilitation Engineering, vol. 12, No. 2, Jun. 2004.
"At-home fishing", http:www.virtualpet.com/vp/media/fishing/homef.jpg (accessed on Jan. 14, 2010).
"Get Bass," Videogame by Sega, The International Arcade Museum and the KLOV (accessed at http://www.arcade-museum.com/game_detail.php?game_id=7933 on Jul. 29, 2011).
"Glove-based input interfaces" Cyberglove/Cyberforce, http://www.angelfire.com/ca7/mellott124/glove1.htm (accessed on Jul. 29, 2011).
"Harry Potter Magic Spell Challenge," Tiger Electronics, 2001.
"Imp Coexists With Your Mouse," Byte, p. 255 (Jan. 1994).
Kirby Tilt 'n' Tumble (GCN-GBA Spaceworld 2001, You Tube Video, uploaded by adonfjv on Sep. 5, 2006 (accessed at http://www.youtube.com/watch?v=5rLhlwp2iGk on Sep. 7, 2011; digital video available upon request).
"Kirby Tilt 'n' Tumble 2" http://www.unseen64.net/2008/04/08/koro-koro-kirby-2-kirby-tilt-n-tumble-2-gc-unreleased/, Apr. 8, 2008 (accessed on Jul. 29, 2011).
"MEMS enable smart golf clubs," Small Times, Jan. 6, 2005, accessed at http://dpwsa.electroiq.com/index/display/semiconductors-article-display/269788/articles/small-times/consumer/2005/01/mems-enable-smart-golf-clubs.html on Jul. 29, 2011.
"Miacomet and Interact Announce Agreement to Launch Line of Reel Feel™ Sport Controllers", PR Newswire (May 13, 1999), accessed at http://www.thefreelibrary.com/_print/PrintArticle.aspx?id=54621351 on Sep. 7, 2011.
"The N.I.C.E. Project," YouTube video uploaded by evltube on Nov. 20, 2007 (accessed at http://www.youtube.com/watch?v=ihGXa21qLms on Sep. 8, 2011; digital video available upon request).
"212 Series of Decoders" HT12D/HT12F by HOLTEK—Product Specification (Nov. 2002).
"212" Series Encoders" HT12A/HT12E by HOLTEK—Product Specification (Apr. 2000).
"ASCII Entertainment releases the Grip," ASCII Entertainment Software—Press News—Coming Soon Magazine, May 1997 (electronic version accessed at http://www.csoon.com/issue25/p_ascii4.htm on Sep. 6, 2011).
"Emerald Forest Toys" [online] [retrieved on Sep. 14, 2005], retrieved from Internet <URL:http://www.pathworks.net/print_eft.html>.
"Enchanted Spell-Casting Sorcerers Wand" by Ken Holt as featured on www.inventionconnection.com online advertisement (Dec. 2002).
"Eyetoy demo from 2000—3d motion cap with a hand-held wand," YouTube Video uploaded by MuchRockness on Mar, 14, 2010 (accessed at http://www.youtube.com/watch?NR=1&v=mheOtyWNjV0 on Sep. 6, 2011; digital video available upon request).
"Gatemaster Features", internet article, Jul. 9, 1997; http://web.archive.org/web/19970709135000/www.gatemaster.com/gmfeat.htm (accessed on Dec. 11, 2008).
"Interview with Pat Goschy, the "Real" Nintendo Wii Inventor," YouTube video uploaded by agbulls on Jan. 14, 2008 (accessed at

(56) **References Cited**

OTHER PUBLICATIONS

http://www.youtube.com/watch?v=oKtZysYGDLE on Feb. 11, 2011; digital video available upon request).
"Micro Tilt Switch" D6B by Omron® Product Specification.
"Nintendo Wii Controller Invented by Americans: Midway Velocity Controller Technology Brief," You Tube Video presentation dated Jun. 28, 2000; uploaded by drjohniefever on Sep. 8, 2007 (accessed at http://www.youtube.com/watch?v=wjLhSrSxFNw on Jun. 30, 2010; digital video available upon request).
"Ollivanders: Makers of Fine Wands." Dec. 2, 2002. [online] [retrieved on Mar. 30, 2005], Retrieved from Internet <URL:http//www.cim.mcgill.edu/!jer/courses/hci/assignments/2002/www.ece.mcgill.ca/%07Eeuryd>.
"Owl Magic Wand and Owl Magic Orb" Press Release by Emerald Forest Toys (Nov. 2001).
"Raise High the 3D Roof Beam: Kids shape these PC games as they go along." By Anne Field, article as featured in Business Week 2001.
"Serial-in Parallel-out Shift Register" SN54/74LS164 by Motorola-Product Specification.
"Sony PS2 Motion Controller 5 years ago (2004)," YouTube Video uploaded by r1oot on Jul. 8, 2009 (accessed at http://www.youtube.com/watch?v=JbSzmRt7HhQ&feature=related on Sep. 6, 2011; digital video available upon request).
"The Big Ideas Behind Nintendo's Wii," Business Week, Nov. 16, 2006 (accessed at http://www.businessweek.com/technology/content/nov2006/tc20061116_750580.htm on Aug. 31, 2011).
"The Magic Labs Conjure Wands" as featured on www.magic-lab.com Product Specification Dec. 2002.
"Tilt Switch" by Fuji & Co. as featured on www.fuji-piezo.com online advertisement May 2001.
"Toy Wand Manufacturer Selects MEMSIC Sensor: Magic Labs cuts costs with MEMSIC sensor" Press Release by MEMSIC, Inc. as featured on www.memsic.com May 2002.
"Wii Mailbag," IGN.com, Jan. 26, 2006 (accessed at http://uk.wii.ign.com/mail/2006-01-26.html on Aug. 31, 2011).
ACT Labs, Miacomet Background, Jan. 27, 2001, http://web.archive.org/web/200101271753/http://www.act-labs.com/ realfeel_background.htm, (accessed on Sep. 7, 2011).
AirPad Controller Manual, (AirPad Corp. 2000).
Airpad Motion Reflex Controller for Sony Playstation—Physical Product, (AirPad Corp. 2000).
Analog Devices "ADXL202E Low-Cost .+-.2 g Dual-Axis Accelerometer with Duty Cycle Output" Data Sheet, Rev. A (2000).
Analog Devices "ADXL330 Small, Low Power, 3-Axis ±2 g iMEMS Accelerometer" Data Sheet, Rev. PrA (2005).
Analog Devices "ADXL50 Monolithic Accelerometer with Signal Conditioning" Data Sheet (1996).
Analog Devices "ADXL50 Single Axis Accelerometer" Data Sheet, Rev. B (1996), available at http://www.analog.com/en/obsolete/adxl50/products/product.html.
Analog Devices "ADXRS150±150%s Single Chip Yaw Rate Gyro with Signal Conditioning" Data Sheet, Rev. B (2004).
Analog Devices "ADXRS401 ±75%s Single Chip Yaw Rate Gyro with Signal Conditioning" Data Sheet, Rev. O (2004).
Analog Devices "MicroConverter®, Multichannel 12-Bit ADC with Embedded Flash MCU, ADuC812" Data Sheet (2003), available at http://www.analog.com/static/imported-files/data_sheets/ADUC812.pdf.
Analog Devices, "ADXL150/ADXL250, ±5g to ±50g, Low Noise, Low Power, Single/Dual Axis iMEMS® Accelerometers," Data Sheet, Rev. 0 (1998).
Ascension Technology, 6D Bird Class B Installation and Operation Guide (2003).
ASCII, picture of one-handed controller, 2 pages, Feb. 6, 2006.
BBN Report No. 7661, "Virtual Environment Technology for Training (VETT)," The Virtual Environment and Teleoperator Research Consortium (VETREC), pp. III-A-27 to III-A-40 (Mar. 1992).
BEI Gyrochip™ Model QRS11 Data Sheet, BEI Systron Donner Inertial Division, BEI Technologies, Inc., (Sep. 1998).
Briefs, (New & Improved), (Brief Article), PC Magazine, Oct. 26, 1993.
Business Wire, "Feature/Virtual reality glasses that interface to Sega channel,Time Warner, TCI; project announced concurrent with COMDEX," Nov. 14, 1994 (accessed at http://findarticles.com/p/articles/mi_m0EIN/is_1994_Nov_14/ai_15923497/?tag=content;col1 on Jul. 7, 2010).
Business Wire, "Free-space 'Tilt' Game Controller for Sony Playstation Uses Scenix Chip; SX Series IC Processes Spatial Data in Real Time for On-Screen," Dec. 6, 1999 (accessed at http://findarticles.com/p/articles/mi_m0EIN/is_1999_Dec_6/ai_58042965/?tag=content;col1 on Jul. 7, 2010)).
Business Wire, "Logitech MAGELLAN 3D Controller," Apr. 14, 1997 (accessed at http://www.thefreelibrary.com/_/print/PrintArticle.aspx?id=19306114 on Feb. 10, 2011).
Business Wire, "Mind Path Introduces GYROPOINT RF Wireless Remote," Jan. 27, 2000 (accessed at http://www.allbusiness.com/company-activities-management/operations-office/6381880-1.html on Jun. 17, 2010).
Business Wire, "Pegasus' Wireless PenCell Writes on Thin Air with ART's Handwriting Recognition Solutions," Business Editors/High Tech Writers Telecom Israel 2000 Hall 29, Booth 19-20, Nov. 7, 2000 (accessed at http://www.highbeam.com/doc/1G1-66658008.html on Jun. 17, 2010).
Business Wire, "RPI ships low-cost pro HMD Plus 3D Mouse and VR PC graphics card system for CES," Jan. 9, 1995 (accessed at http://www.highbeam.com/doc/1G1-16009561.html on Jun. 17, 2010).
Business Wire, "InterSense Inc. Launches InertiaCube2—The World's Smallest Precision Orientation Sensor with Serial Interface," Aug. 14, 2001 (accessed at http://www.highbeam.com/doc/1G1-77183067.html/print on Sep. 7, 2011.
CNET News.com, "Nintendo Wii Swings Into Action," May 25, 2006 (accessed at http://news.cnet.com/2300-1043_3-6070295-4.html on Aug. 5, 2011).
Complainants' Petition for Review, dated Sep. 17, 2012.
Complainants' Response to Commission's Request for Statements on the Public Interest, dated Oct. 10, 2012.
Complainants' Response to Respondents' Petition for Review, dated Sep. 25, 2012.
CSIDC Winners—"Tablet-PC Classroom System Wins Design Competition," IEEE Computer Society Press, vol. 36, Issue 8, pp. 15-18, IEEE Computer Society, Aug. 2003.
Digital ID Cards the next generation of 'smart' cards will have more than a one-track mind. Wall Street Journal, Jun. 25, 2001.
Expert Report of Kenneth Holt on Behalf of Respondents Nintendo of America, Inc. and Nintendo Co., Ltd., dated Nov. 3, 2011.
Expert Report of Nathaniel Polish, Ph.D. on Behalf of Respondents Nintendo of America, Inc. and Nintendo Co., Ltd., dated Nov. 3, 2011.
FrontSide Field Test, "Get This!" Golf Magazine, Jun. 2005, p. 36.
gamecubicle.com News Article, Nintendo WaveBird Controller, http://www.gamecubicle.com/news-Nintendo_gamecube_wavebird_controller.htm, May 14, 2002 (accessed on Aug. 5, 2011).
Gyration Ultra Cordless Optical Mouse, User Manual, Gyration, Inc., Saratoga, CA (2003).
Gyration, "Gyration MicroGyro 100 Developer Kit Data Sheet," http://web.archive.org/web/19980708122611/www.gyration.com/html/devkit.ht-ml (Jul. 1998).
Gyration, Inc., GyroRemote GP240-01 Professional Series (2003).
HiBall-3100—"Wide-Area, High-Precision Tracker and 3D Digitizer," www.3rdtech.com/HiBall.htm (accessed on Jul. 29, 2011).
Immersion CyberGlove product, Immersion Corporation, http://www.cyberglovesystem.com (2001).
Immersion, "Immersion Ships New Wireless CyberGlove(R) II Hand Motion-Capture Glove; Animators, Designers, and Researchers Gain Enhanced Efficiency and Realism for Animation, Digital Prototyping and Virtual Reality Projects," Business Wire, Dec. 7, 2005 (available at http://ir.immersion.com/releasedetail.cfm?releaseid=181278).
Initial Determination on Violation of Section 337 and Recommended Determination on Rememdy and Bond, dated Aug. 31, 2012.
Interfax Press Release, "Tsinghua Tongfang Releases Unique Peripheral Hardware for 3D Gaming," 2002, 1 page.

(56) **References Cited**

OTHER PUBLICATIONS

International Preliminary Examination Report, International App. No. PCT/US00/09482; dated Apr. 24, 2001; 4 pages.
International Search Report and Written Opinion, International App. No. PCT/US05/34831; mailed Jul. 2, 2008; 11 pages.
International Search Report and Written Opinion; International Appl. No. PCT/US2006/043915; mailed Mar. 9, 2007; 8 pages.
Intersense, "InterSense InertiaCube2 Manual for Serial Port Model" (2001).
Intersense, "InterSense Inc., The New Standard in Motion Tracking," Mar. 27, 2004, http://web.archive,org!web12004040500550Z/http://intersense.com (accessed on May 19, 2009).
Intersense, "InterSense Mobile Mixed Reality Demonstration," YouTube Video dated Oct. 2006 on opening screen; uploaded by InterSenselnc on Mar. 14, 2008 (accessed at http://www.youtube.com/watch?v=daVdzGK0nUE&feature=channel_page on Sep. 8, 2011; digital video available upon request).
Intersense, "IS-900 Precision Motion Trackers," Jun. 14, 2002, http://web.archive.org/web/20020614110352/http://www.isense.com/products/prec/is900/ (accessed on Sep. 8, 2011).
Intersense, Inc., "Comparison of Intersense IS-900 System and Optical Systems," Whitepaper, Jul. 12, 2004., available at http://www.jazdtech.com/techdirect/research/InterSense-Inc.htm?contentSetId=60032939&supplierId=60018705.
Laser Tag: General info: History of Laser Tag, http://lasertag.org/general/history.html (accessed on Mar. 13, 2008; historical dates start on Mar. 1984).
Laser Tag: Lazer Tag Branded Gear; last update Sep. 26, 2006, http://home.comcast.net/~ferret1963/Lazer_Tag_Brand.HTML (accessed on Mar. 13, 2008; historical dates start in 1986).
Logitech, "Logitech Tracker—Virtual Reality Motion Tracker," downloaded from http://www.vrealities.com/logitech.html on Jun. 18, 2010.
Logitech, Inc. "3D Mouse & Head Tracker Technical Reference Manual," 1992.
Logitech's WingMan Cordless RumblePad Sets PC Gamers Free, Press Release, Sep. 2, 2001 (accessed at http://www.logitech.com/en-us/172/1373 on Aug. 5, 2011).
May 3, 2010 Response to Feb. 5, 2010 Office Action for U.S. Appl. No. 12/222,787, filed Aug. 15, 2008, now U.S. Pat. No. 7,774,155 (including Rule 1.132 Declaration by Steve Mayer).
New Strait Times Press Release, "Microsoft's New Titles," 1998, 1 page.
News Article, "New Game Controllers Using Analog Devices' G-Force Tilt to be Featured at E3", Norwood, MA (May 10, 1999) (accessed at http://www.thefreelibrary.com/_/print/PrintArticle.aspx?id=54592268 on Jun. 17, 2010).
Nintendo Tilt Controller Ad, Electronic Gaming Monthly, 1994, 1 page.
Nintendo, Game Boy Advance SP System Instruction Booklet (2003).
Nintendo, Nintendo Game Boy Advance System Instruction Booklet (2001-2003).
Nintendo, Nintendo Game Boy Advance Wireless Adapter.
Pajama Sam: No Need to Hide When It's Dark Outside Infogrames, Sep. 6, 2002.
PC World, "The 20 Most Innovative Products of the Year," Dec. 27, 2006 (accessed at http://www.pcworld.com/printable/article/id,128176/printable.html on Aug. 2, 2011).
PCT International Search Report and Written Opinion mailed Aug. 26, 2004, App. No. PCT/US04/08912, 7 pages.
PCTracker, Technical Overview, available at http://www.es-tkl.com/fileadmin/media/pdf/InterSense/PCTracker_Tech_Overview.pdf.
Petition of the Office of Unfair Import Investigations for Review-in-Part of the Final Initial Determination, dated Sep. 17, 2012.
Polhemus, "Polhemus 3Space Fastrak devices" (image) (2001).
PowerGlove product Program Guide, Mattel, 1989.
PowerGlove product Program Guide, Mattel, 1989 (Text of Program Guide provided from http://hiwaay.net/~lkseitz/cvtg/power_glove.shtml; the text was typed in by Lee K. Sietz; document created Aug. 25, 1988; accessed on Aug. 2, 2011).
PR Newswire, "Five New Retailers to Carry Gyration's Gyropoint Point and Gyropoint Pro," Jul. 8, 1996 (accessed at http://www.thefreelibrary.com/_/print/PrintArticle.aspx?id=54592268 on Jun. 18, 2010).
PR Newswire, "Three-Axis MEMS-based Accelerometer From STMicroelectronics Targets Handheld Terminals," Feb. 18, 2003 (accessed at http://www.thefreelibrary.com/_/print/PrintArticle.aspx?id=54592268 on Aug. 3, 2011).
Pre-Hearing Statement of Complainants Creative Kindoms, LLC and New Kingdoms, LLC, dated Jan. 13, 2012.
Radica Legends of the Lake™ Instruction Manual (2003).
Respondents Nintendo Co., Ltd. and Nintendo of America Inc.'S Contingent Petition for Review of Initial Determination, dated Sep. 17, 2012.
Respondents Nintendo Co., Ltd. and Nintendo of America Inc.'s Objections and Supplemental Responses to Complainants Creative Kingdoms, LLC and New Kingdoms, LLC'S Interrogatory Nos. 35, 44, 47, 53, and 78, dated Oct. 13, 2011.
Respondents Nintendo Co., Ltd. and Nintendo of America Inc.'s Response to Complainants' and Staff's Petitions for Review, dated Sep. 25, 2012.
Response of the Office of Unfair Import Investigations to the Petitions for Review, dated Sep. 25, 2012.
Response to Office Action dated Sep. 18, 2009 for U.S. Appl. No. 11/404,844.
Sega/Sports Sciences, Inc., "Batter Up, It's a Hit," Instruction Manual, Optional Equipment Manual (1994).
Sega/Sports Sciences, Inc., "Batter Up, It's a Hit," Photos of baseball bat (1994).
Selectech Airmouse, "Mighty Mouse", Electronics Today International, p. 11 (Sep. 1990).
Smartswing, "SmartSwing: Intelligent Golf Clubs that Build a Better Swing," http://web.archive.org/web/20040728221951/http://www.smartswinggolf.com/ (accessed on Sep. 8, 2011).
Smartswing, "The SmartSwing Learning System Overview," Apr. 26, 2004, http://web.archive.org/web/2004426215355/http://www.smartswinggolf.com/tls/index.html (accessed on Jul. 29, 2011).
Smartswing, "The SmartSwing Learning System: How it Works," 3 pages, Apr. 26, 2004, http://web.archive.org/web/20040426213631/http://www.smartswinggolf.com/tls/how_it_works.html (accessed on Jul. 29, 2011).
Smartswing, "The SmartSwing Product Technical Product: Technical Information," Apr. 26, 2004, http://web.archive.org/web/20040426174854/http://www.smartswinggolf.com/products/technical_info.html (accessed on Jul. 29, 2011).
Tech Designers Rethink Toys: Make Them Fun. Wall Street Journal, Dec. 17, 2001.
Toy Designers Use Technology in New Ways as Sector Matures, WSJ.com, Dec. 17, 2001.
Traq 3D, "Healthcare,"http: //www.traq3d.com/Healthcare/Healthcare.aspx (accessed on Jan. 21, 2010).
UNC Computer Science Department, "News & Notes from Sitterson Hall," UNC Computer Science, Department Newsletter, Issue 24, Spring 1999 (Apr. 1999) (accessed at http://www.cs.unc.edu/NewsAndNotes/Issue24/ on Jun. 18, 2010).
US Dynamics Corp, "Spinning Mass Mechanical Gyroscopes," Aug. 2006.
US Dynamics Corp, "The Concept of 'Rate', (more particularly, angular rate pertaining to rate gyroscopes) (rate gyro explanation)," Aug. 2006.
US Dynamics Corp, "US Dynamics Model 475 Series Rate Gyroscope Technical Brief," Dec. 2005.
US Dynamics Corp, "US Dynamics Rate Gyroscope Interface Brief (rate gyro IO)" Aug. 2006.
U.S. Appl. No. 60/214,317, filed Jun. 27, 2000.
U.S. Appl. No. 60/730,659, filed Oct. 25, 2005 to Marks.
Virtual Fishing, Operational Manual, 2 pages, Tiger Electronics, Inc. (1998).
Zowie Playsets, http://www.piernot.com/proj/zowie/ (accessed on Jul. 29, 2011).

(56) **References Cited**

OTHER PUBLICATIONS

"Coleco Vision: Super Action™ Controller Set," www.vintagecomputing.com/wp-content/images/retroscan/ coleco_sac_1_large.jpg., Sep. 2006.
"Controllers-Atari Space Age Joystic," AtariAge: Have You Played Atari Today? www.atariage.com/controller_page.html?SystemID=2600& ControllerID-12., Sep. 1, 2006.
"Controllers-Booster Grip," AtariAge: Have You Played Atari Today? www.atariage.com/controller_page.html?SystemID=2600& ControllerID=18., Sep. 1, 2006.
"Electronic Plastic: BANDAI—Power Fishing" "Power Fishing Company: BANDAI," 1 page, http://www.handhelden.com/Bandai/PowerFishing.html., 1984 (accessed on Jul. 29, 2011).
"Game Controller" Wikipedia, Jan. 5, 2005.
Bluffing Your Way in Pokemon, Oct. 14, 2002, 7 pages.
Chatfield, "Fundamentals of High Accuracy Inertial Navigation," vol. 174 Progress in Astronautics and Aeronautics, American Institute of Aeronautics and Astronautics, Inc. (1997).
Expert Report of Branimir R. Vojcic, Ph.D. on Behalf of Complainants Creative Kingdoms, LLC and New Kingdoms, LLC, dated Nov. 17, 2011.
Ferrin, "Survey of Helmet Tracking Technologies," Proc. SPIE vol. 1456, p. 86-94 (Apr. 1991).
U.S. Appl. No. 09/520,148, filed Mar. 7, 2000 by Miriam Mawle.
Gyration Ultra Cordless Optical Mouse, Setting Up Ultra Mouse, Gyration Quick Start Card part No. DL-00071-0001 Rev. A. Gyration, Inc., Jun. 2003.
Hogue, Andrew, "MARVIN: A Mobile Automatic Realtime visual and Inertial tracking system," Master's Thesis, York University (2003), available at http://www.cse.yorku.ca/~hogue/marvin.pdf.
IGN Article—Mad Catz Rumble Rod Controller, Aug. 20, 1999.
Intersense, "IS-900 Product Technology Brief," http://www.intersense.com/uploadedFiles/Products/White_--Papers/IS900-_--Tech_--Overview_-- Enhanced.pdf (1999).
Nintendo N64 Controller Pak Instruction Booklet, 1997.
Smartswing, Training Aid, Austin, Texas, Apr. 2005.
Specification of the Bluetooth System—Core v1.0b, Dec. 1, 1999.
Star Wars Action Figure with CommTech Chip by Hasbro (1999).
Stars Wars Episode 1 CommTech Reader Instruction Manual (1998).
Wired Glove, Wikipedia article, 4 pages, http://en.wikipedia.org/wiki/Wired_glove, Nov. 18, 2010.
Public Version of Commission Opinion from United States International Trade Commission, dated Oct. 28, 2013.

* cited by examiner

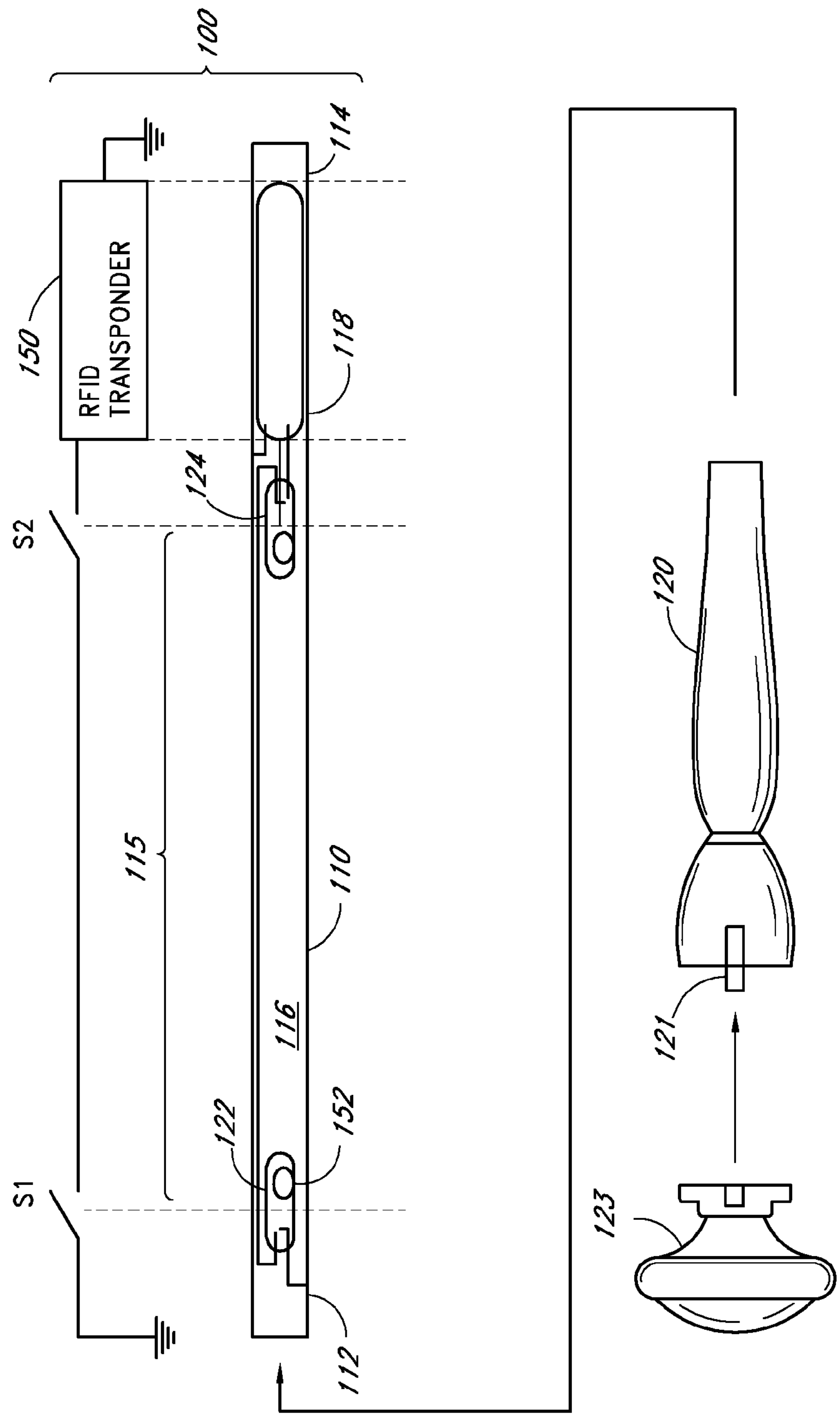
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FIG. 1

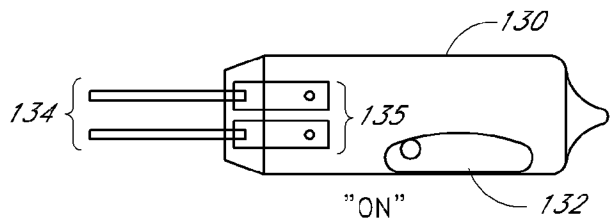

FIG. 2A

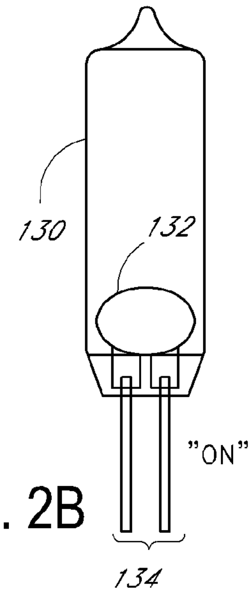

FIG. 2B

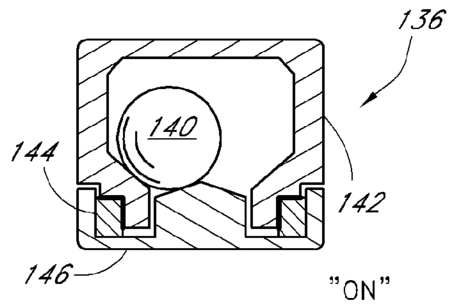

FIG. 3A

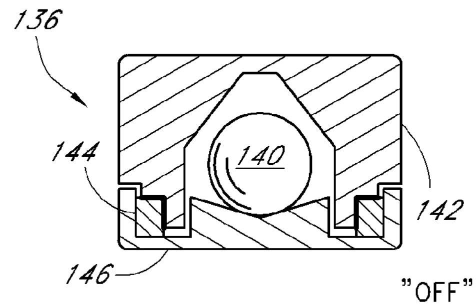

FIG. 4A

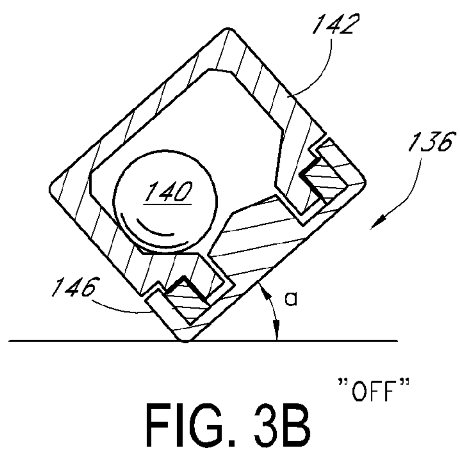

FIG. 3B

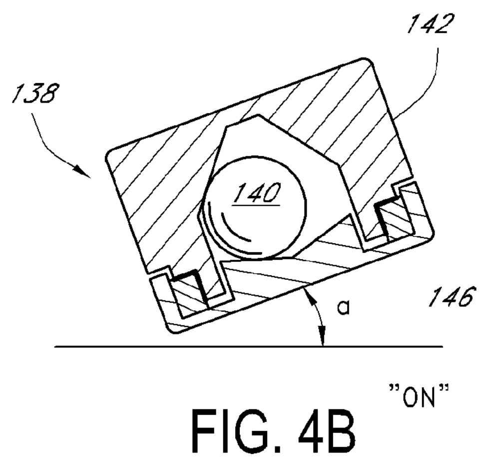

FIG. 4B

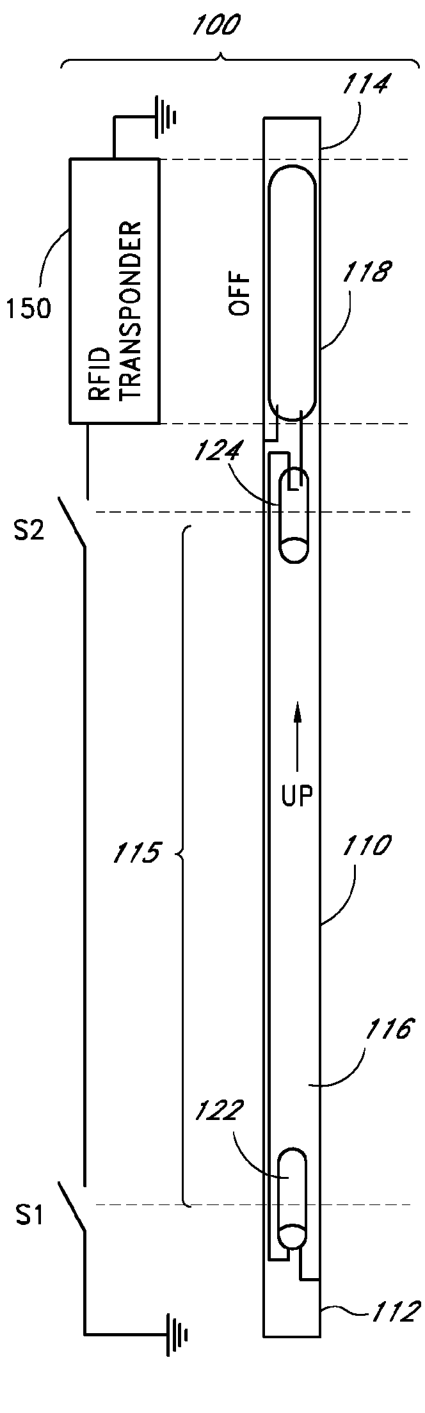
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FIG. 5A

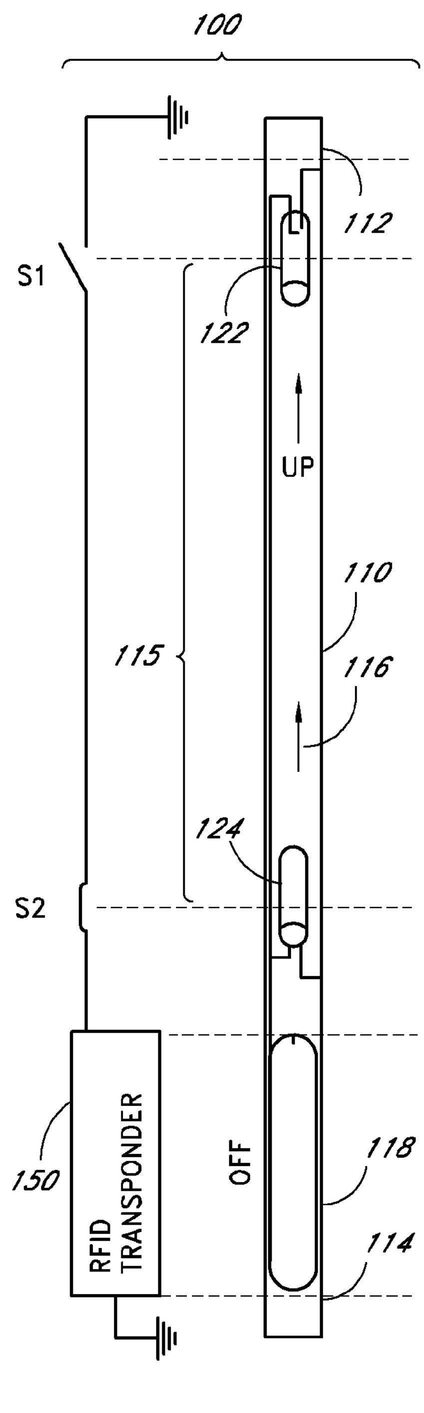
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FIG. 5B

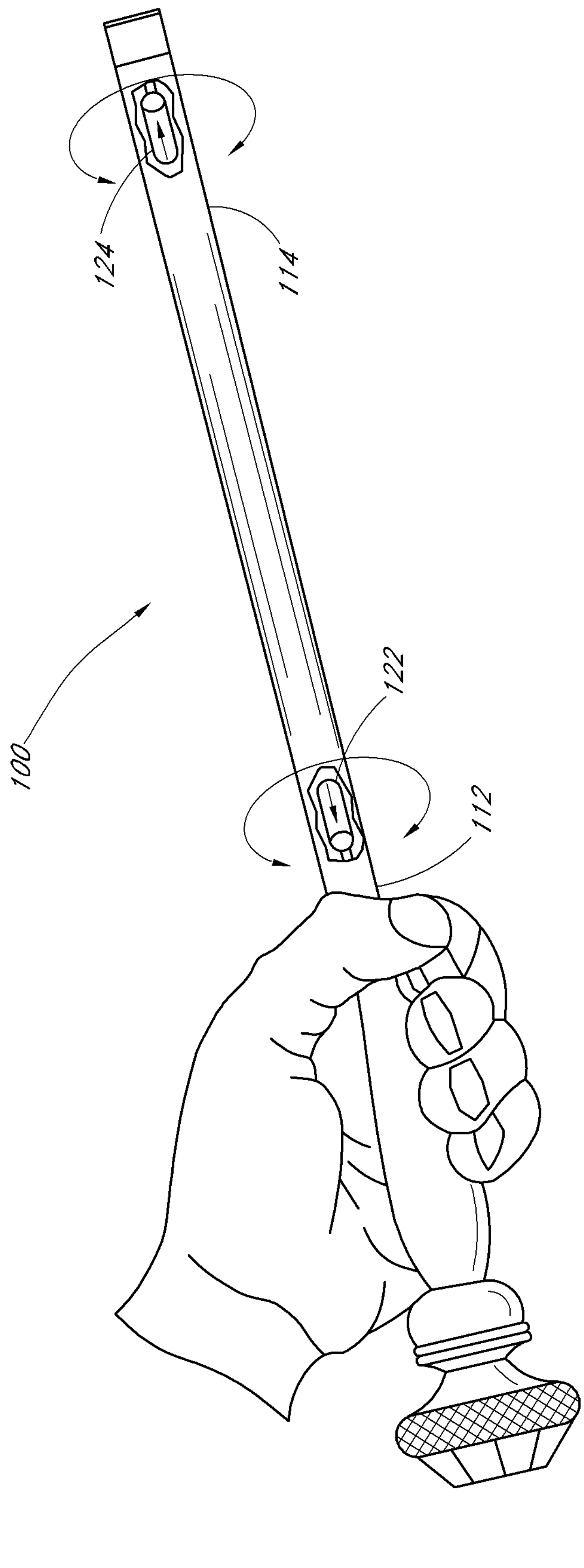

FIG. 6

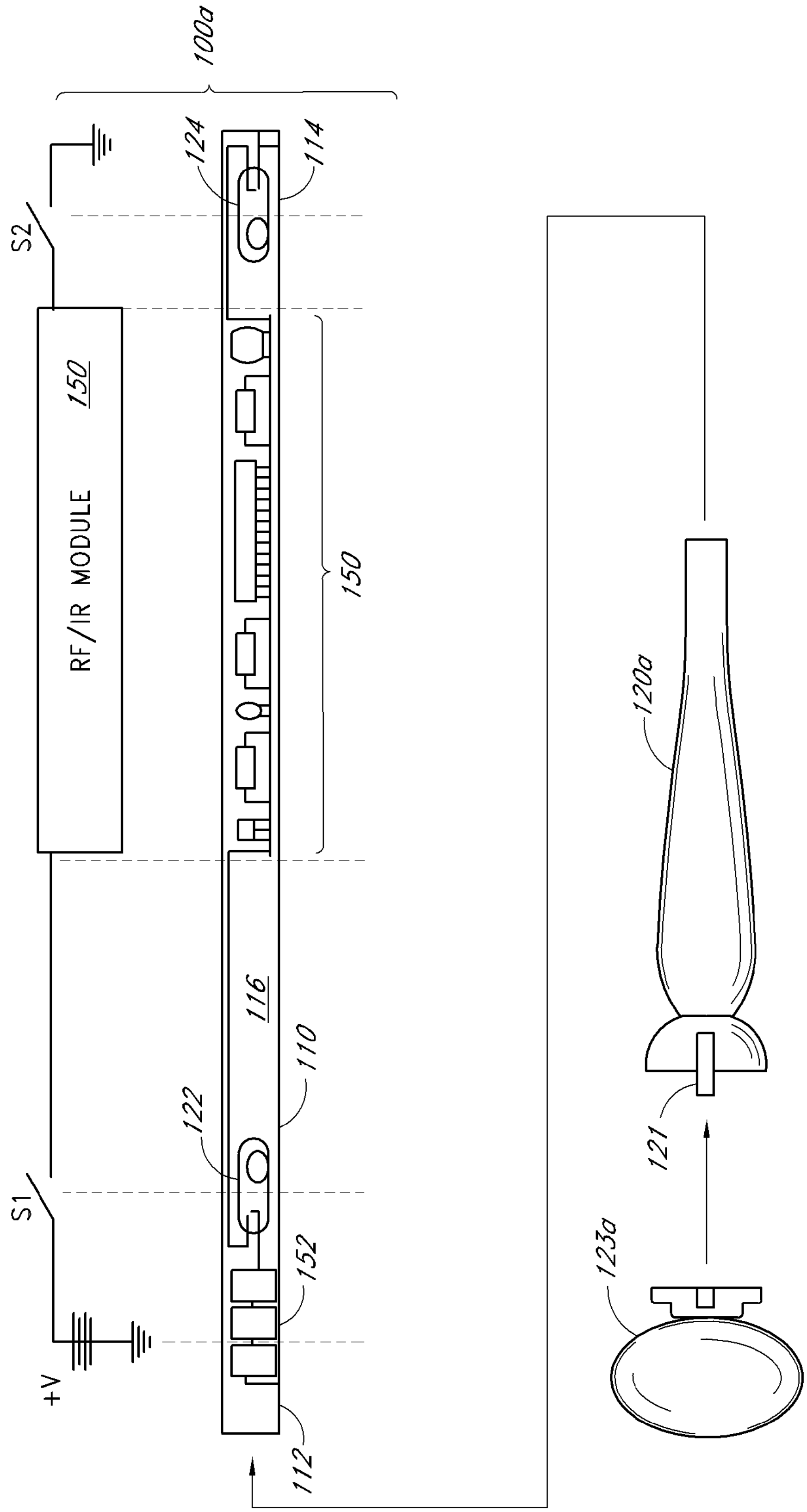
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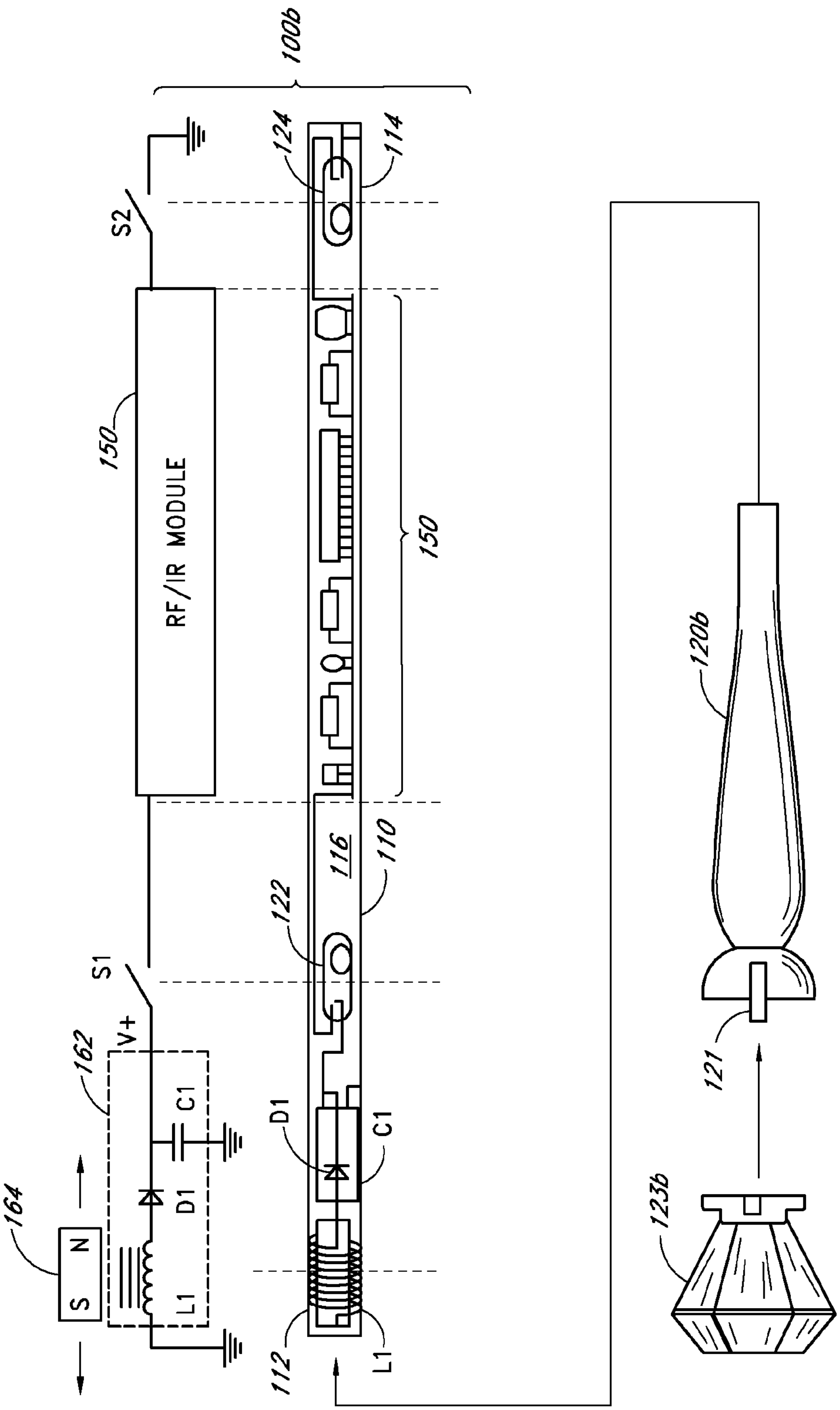
FIG. 7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RF/IR MODULE
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C1
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123b

FIG. 8

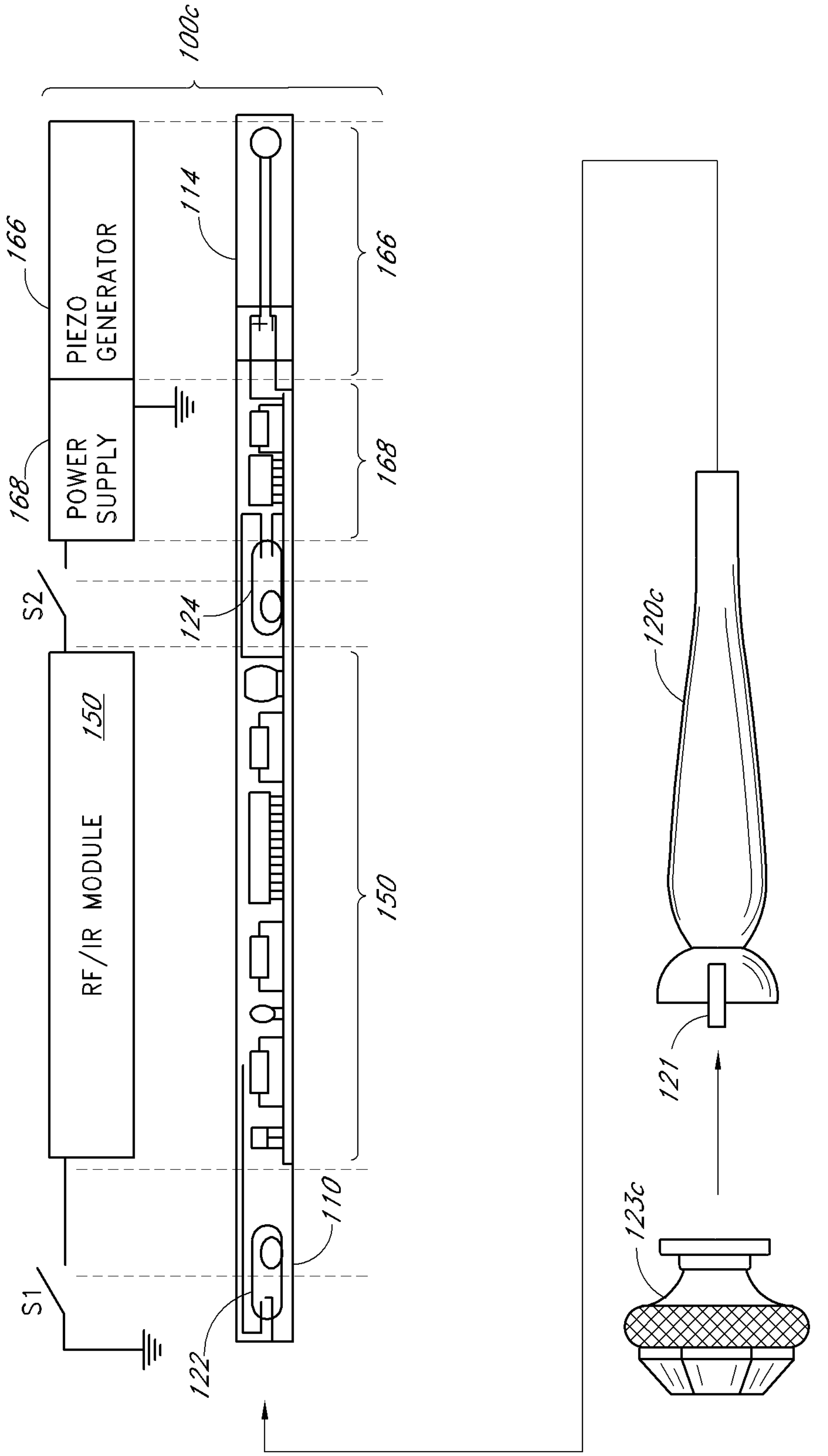
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FIG. 9

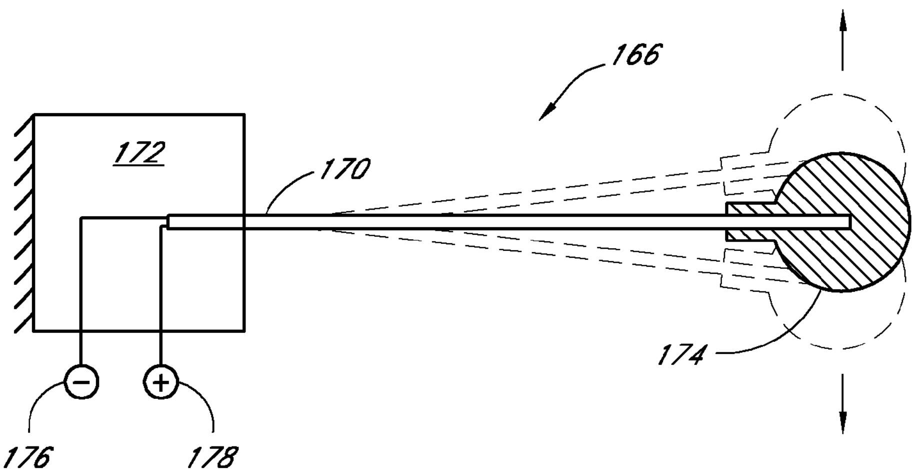
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FIG. 10

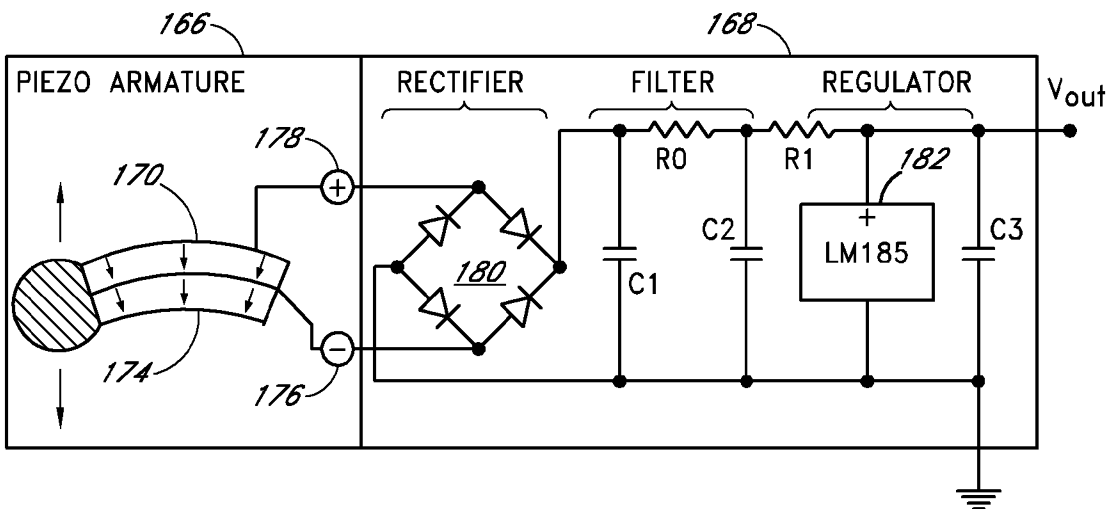
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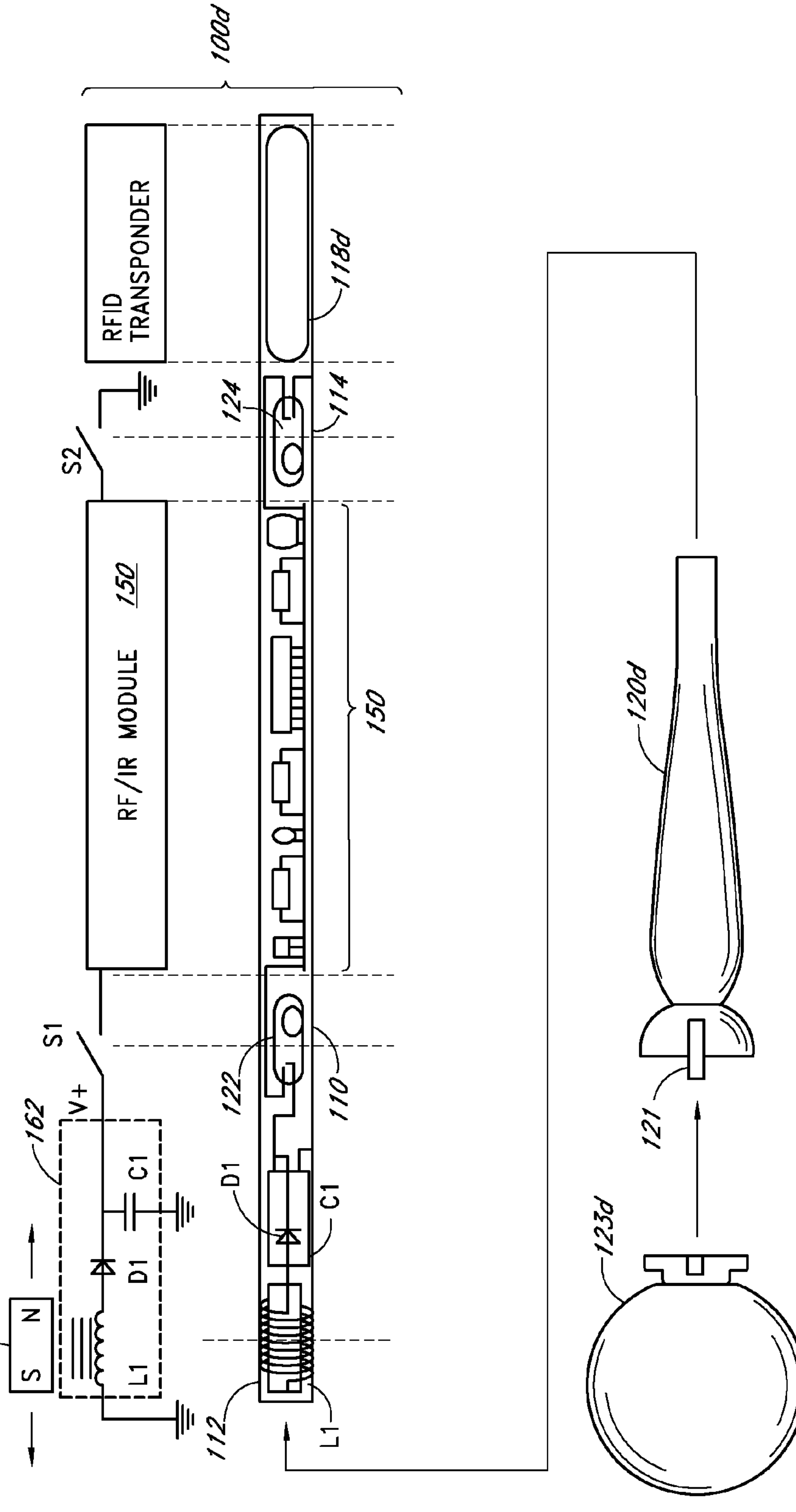
FIG. 11



100d
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S2
RF/IR MODULE 150
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S1
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V+
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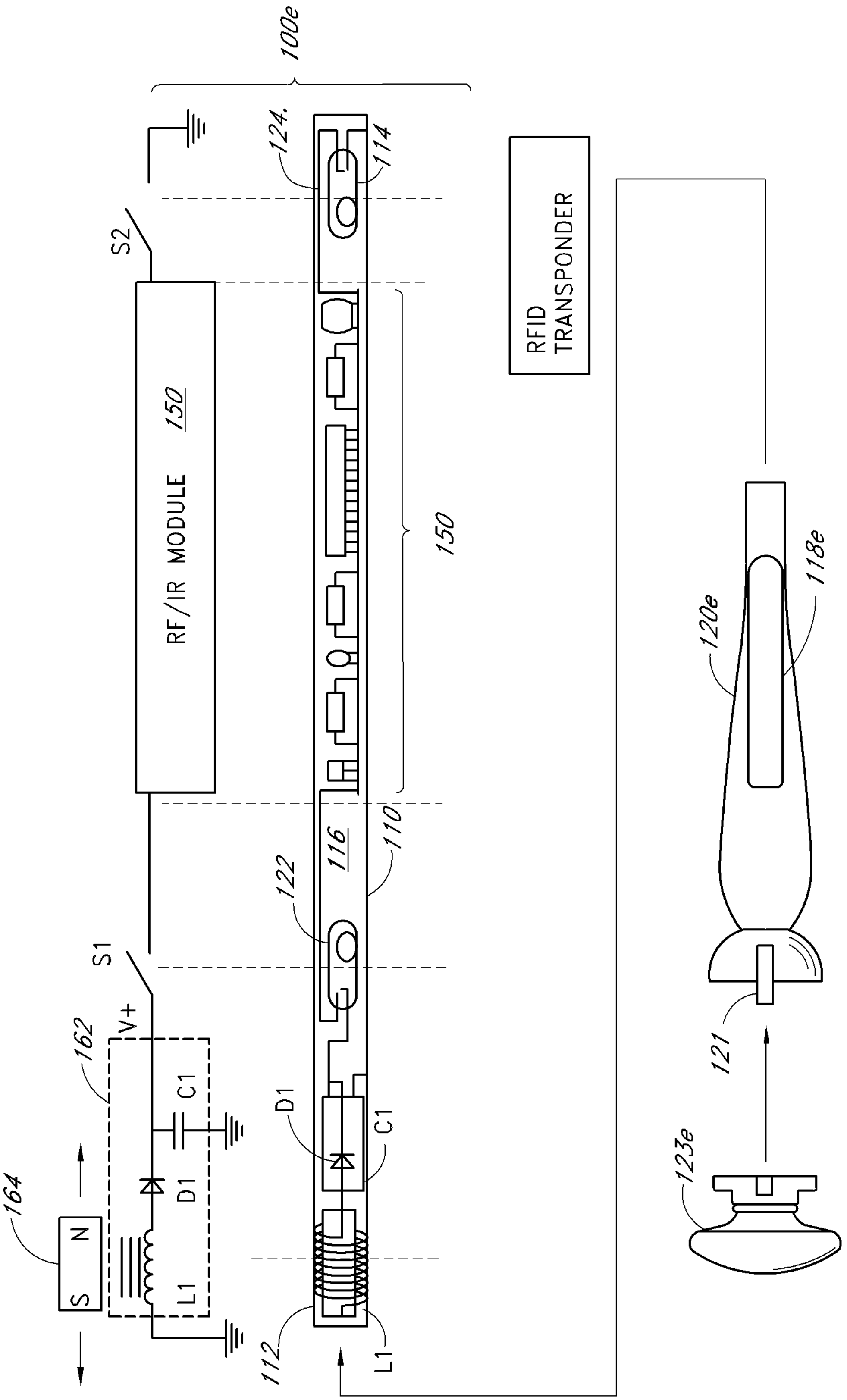
C1
D1
164
S
N
L1
112
121
120d
123d

FIG. 12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L1
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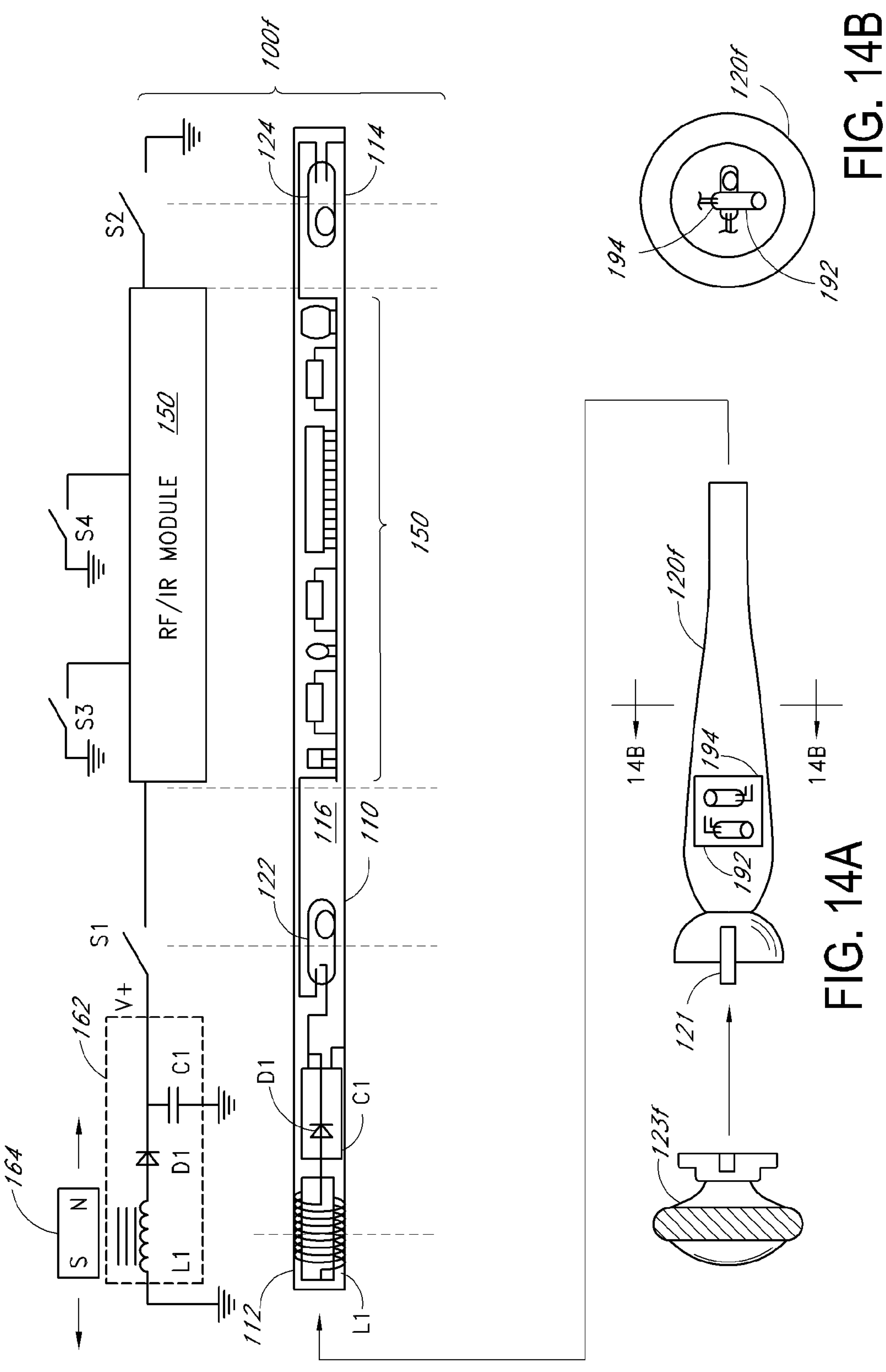
121
123e

FIG. 13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S4
V+
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L1
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C1
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110
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116
122
124
150
120f
121
123f
192
194
14B
FIG. 14A
FIG. 14B

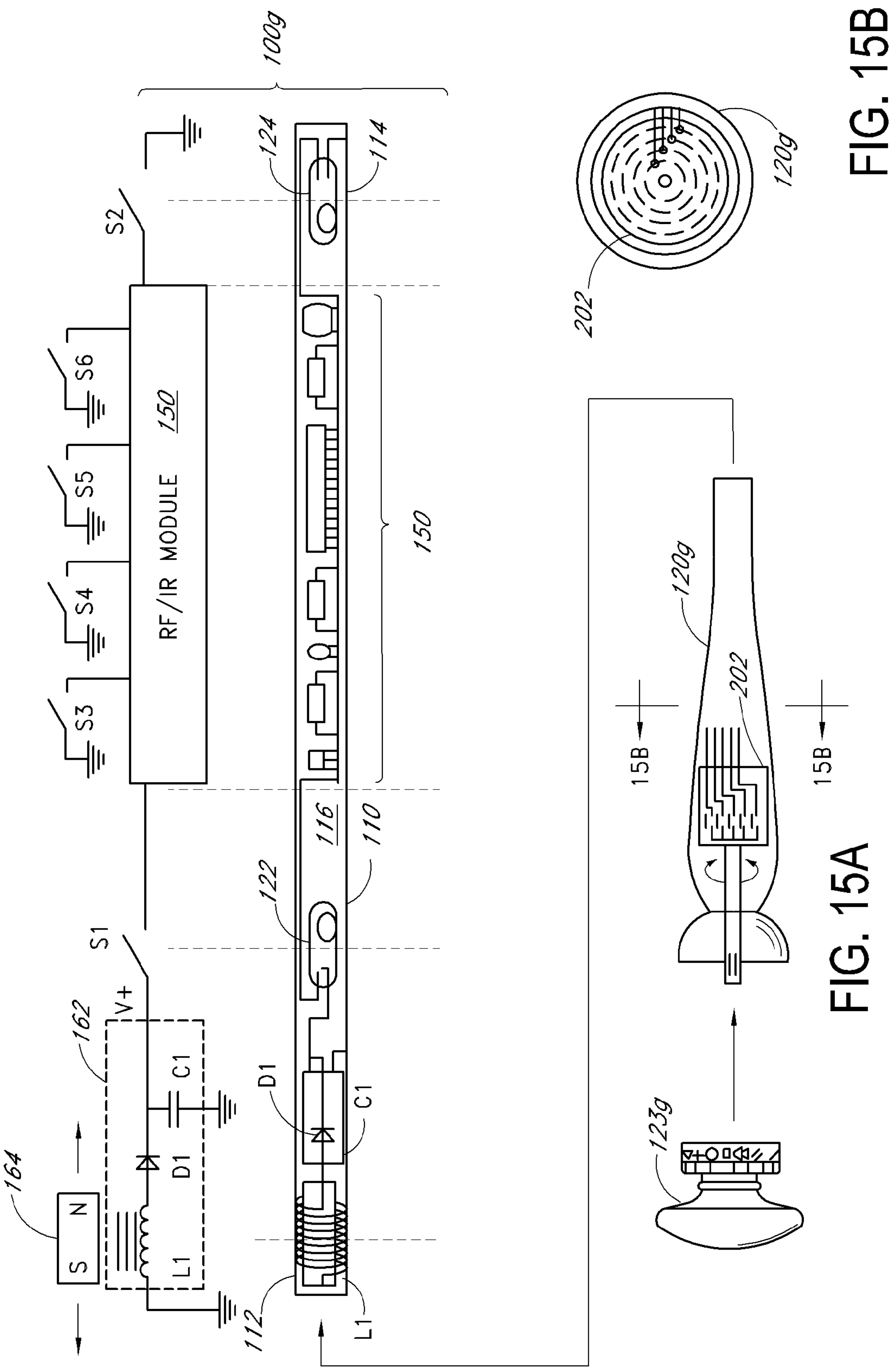


FIG. 15A

FIG. 15B

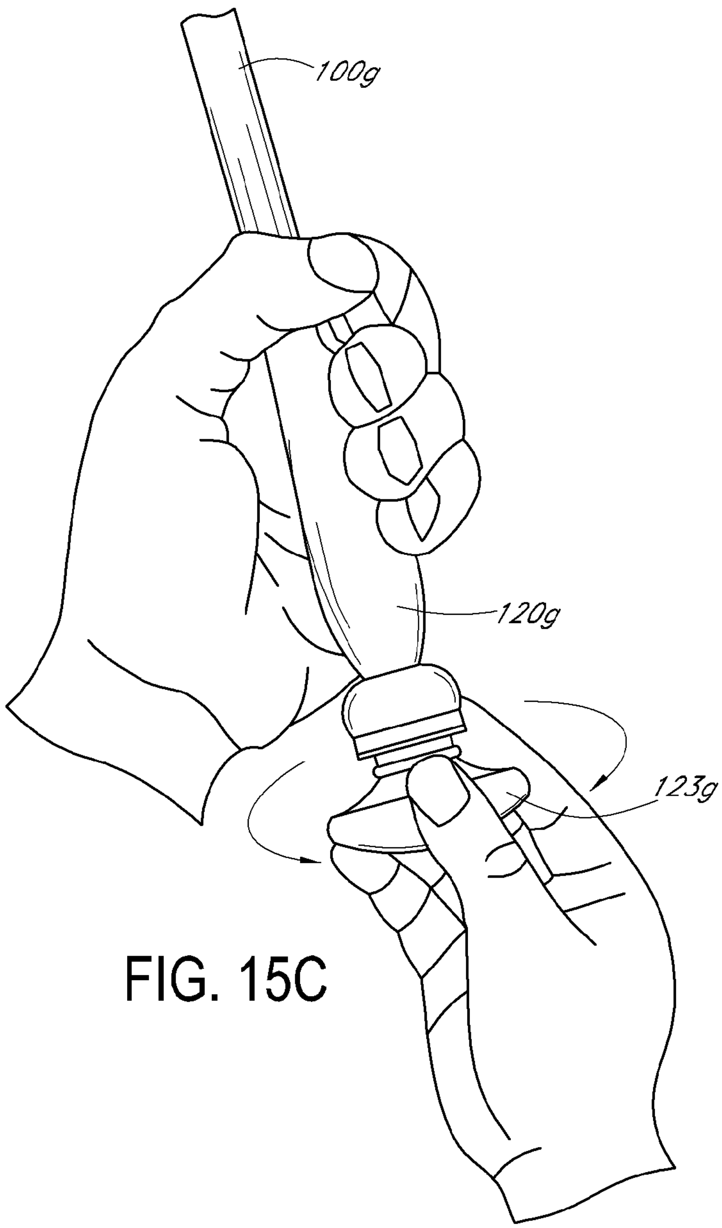


FIG. 15C

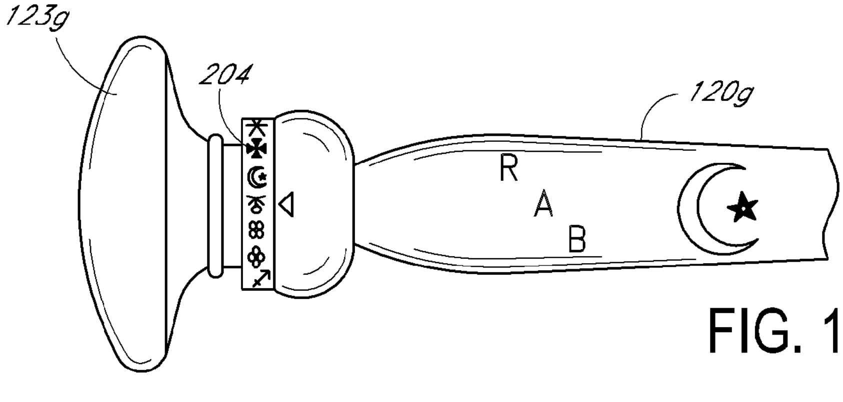


FIG. 15D

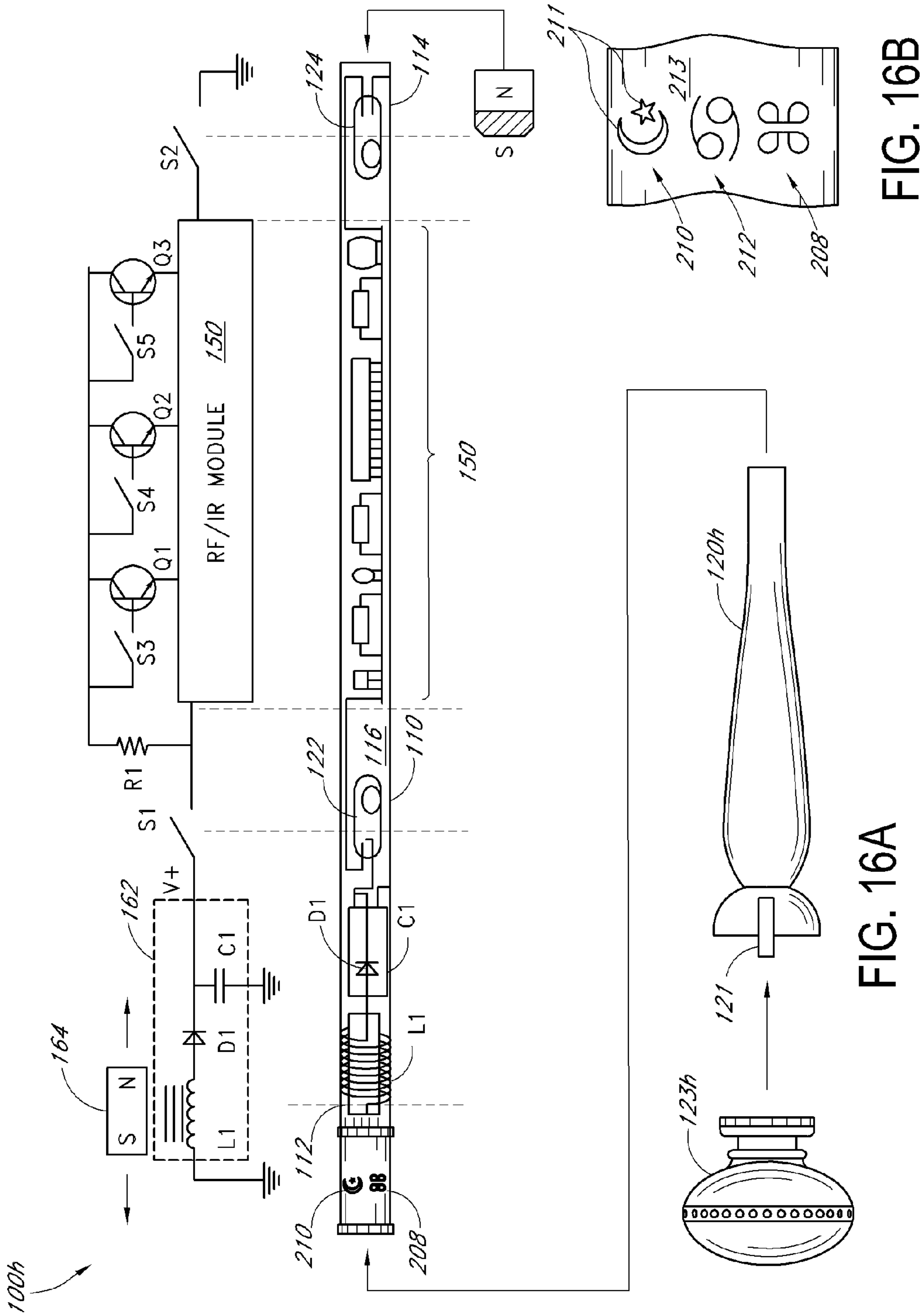


FIG. 16A

FIG. 16B

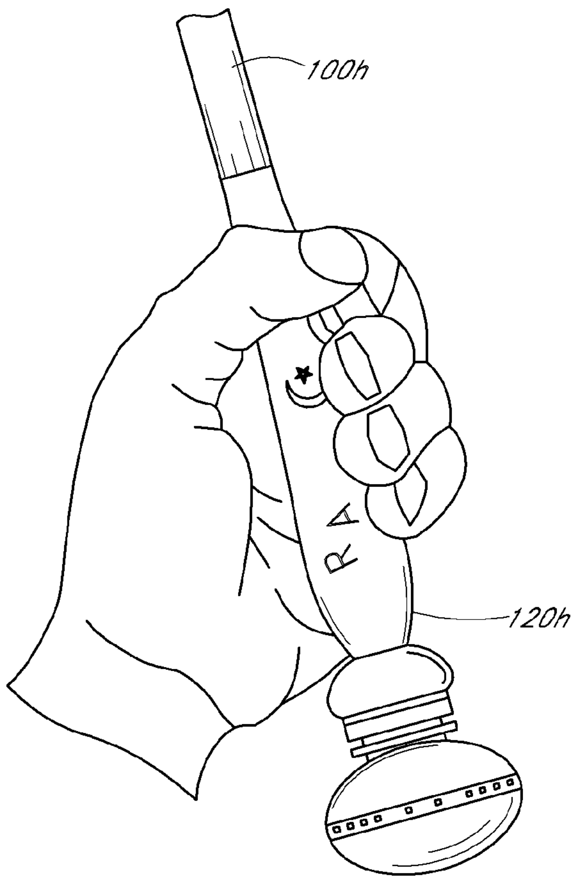


FIG. 16C

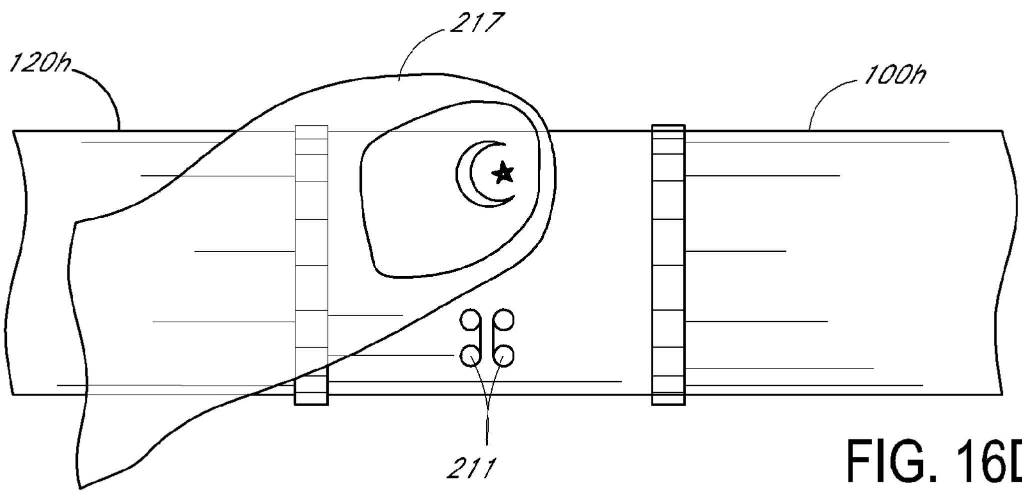


FIG. 16D

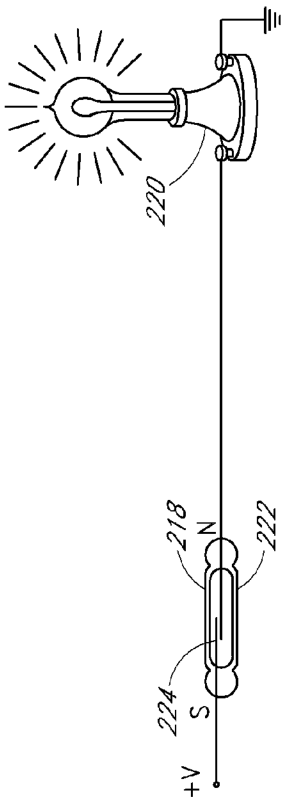


FIG. 17A

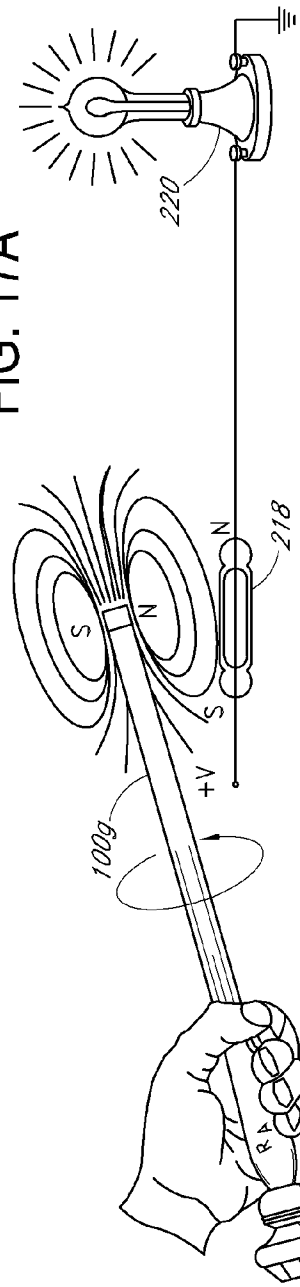


FIG. 17B

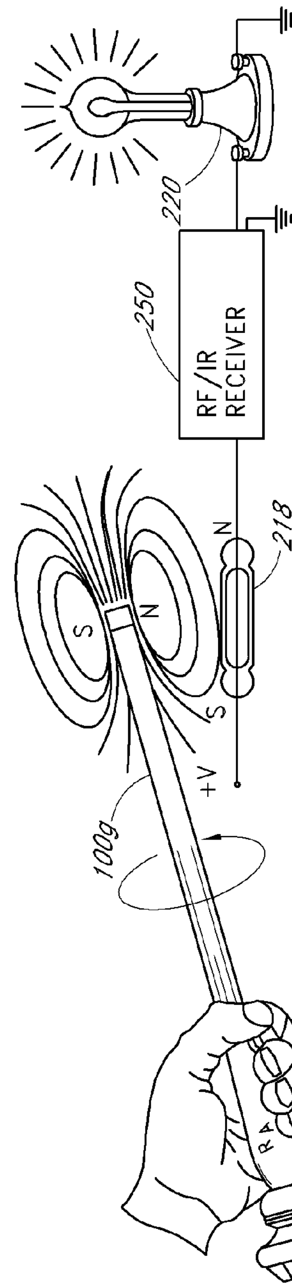


FIG. 17C

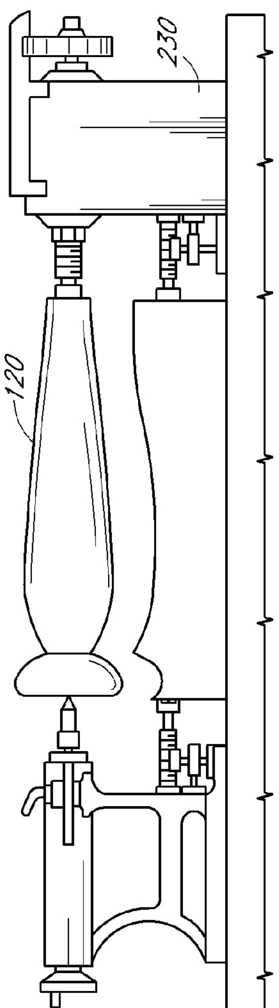


FIG. 18A

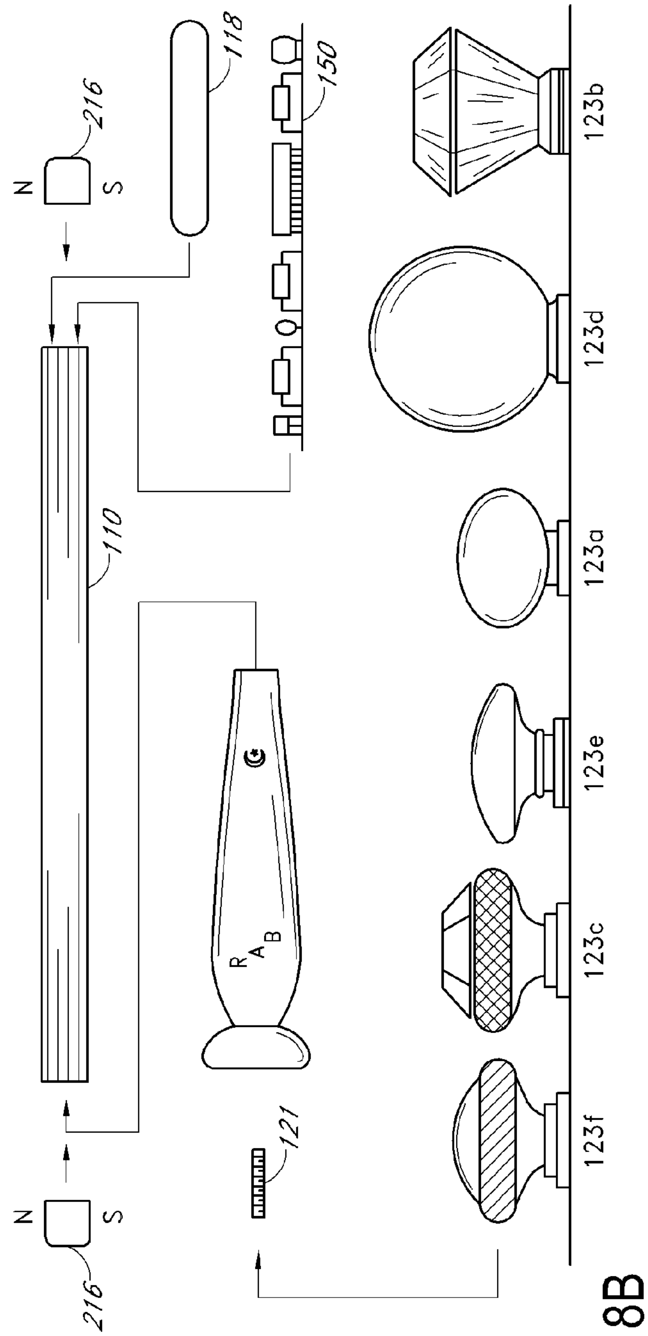


FIG. 18B

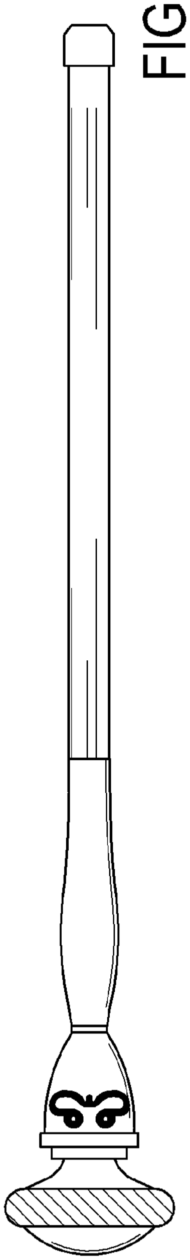


FIG. 19A

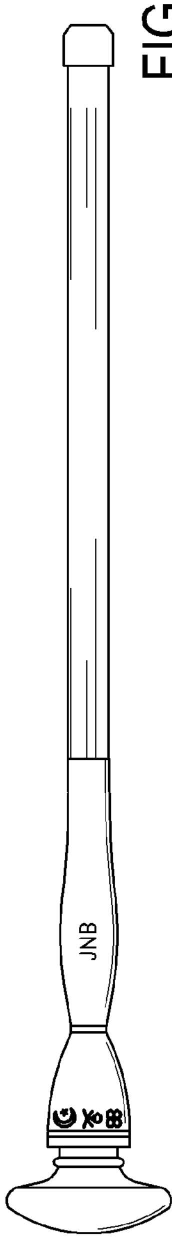


FIG. 19B

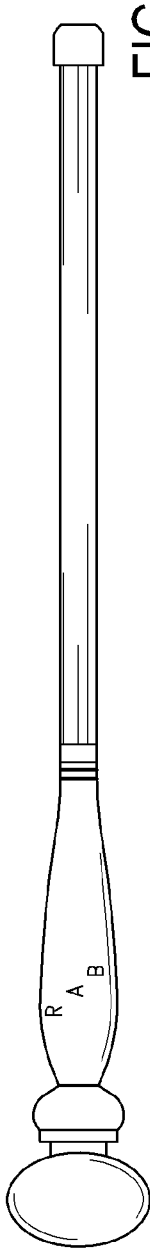


FIG. 19C

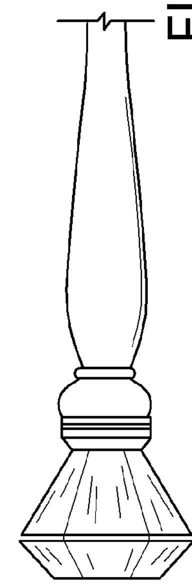


FIG. 19E

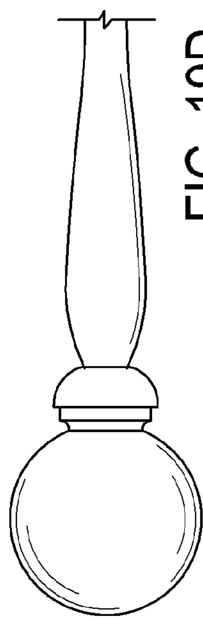


FIG. 19D

FIG. 19F

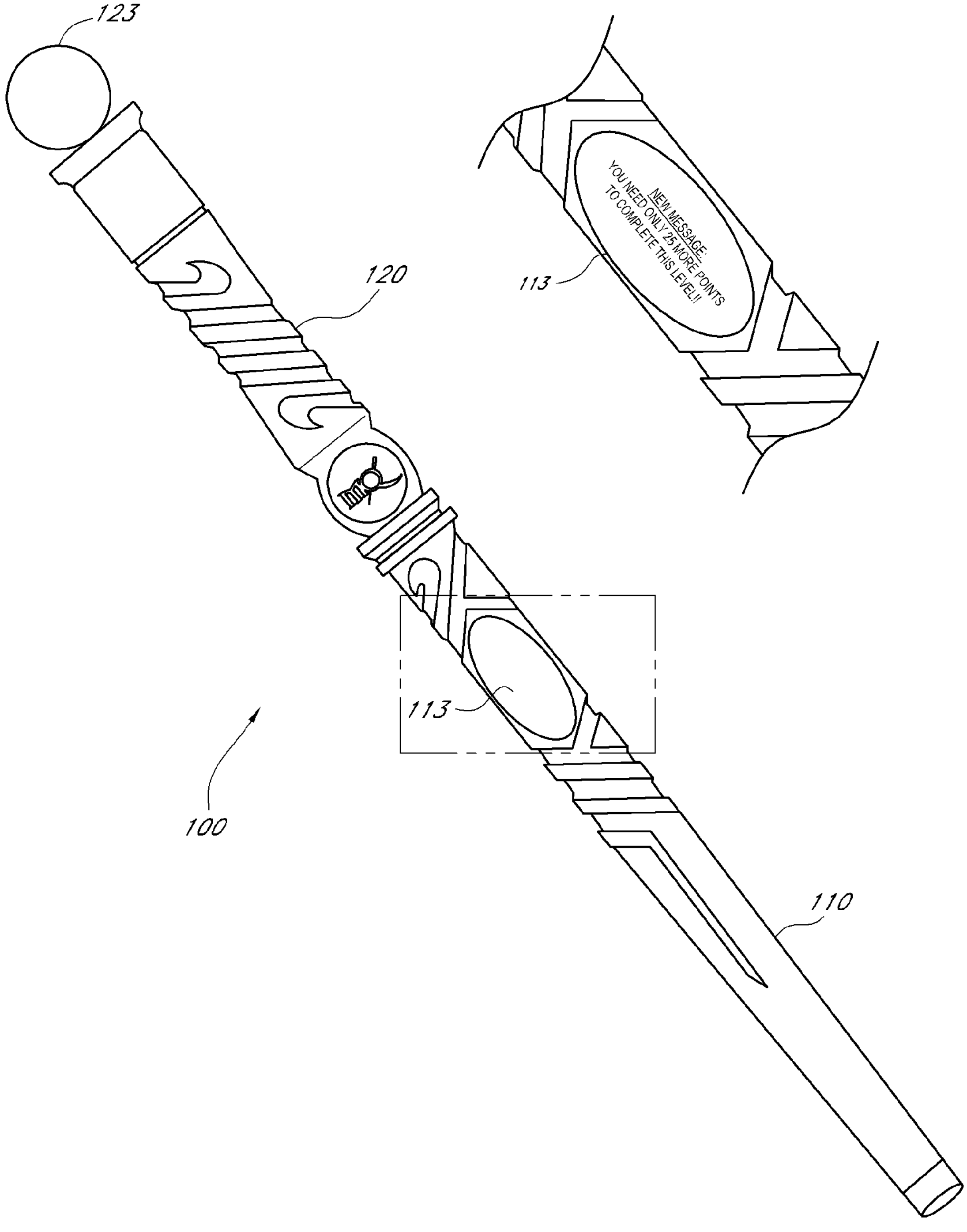

123
120
113
NEW MESSAGE:
YOU NEED ONLY 25 MORE POINTS
TO COMPLETE THIS LEVEL!!
113
100
110

FIG. 19G

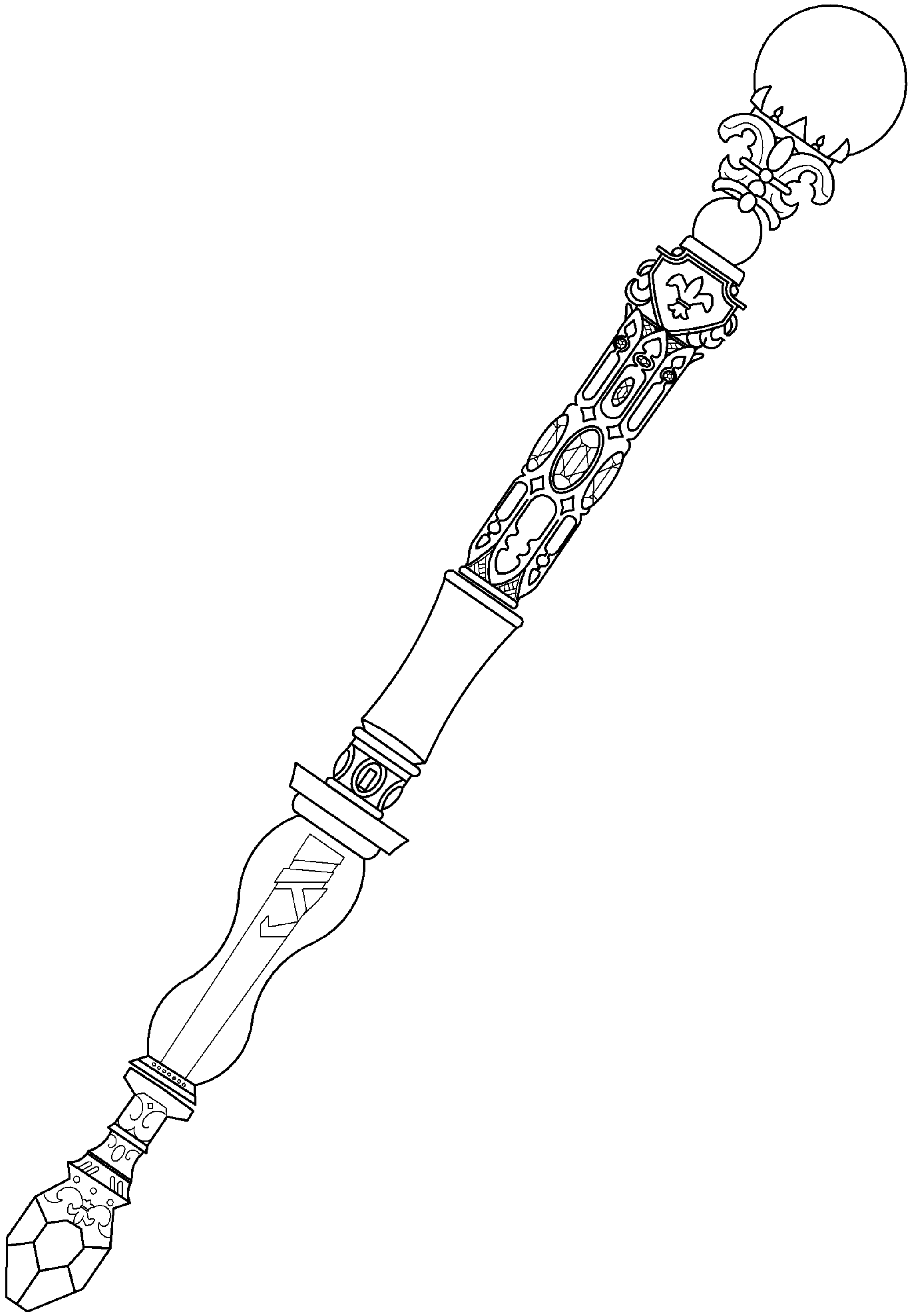


FIG. 19H

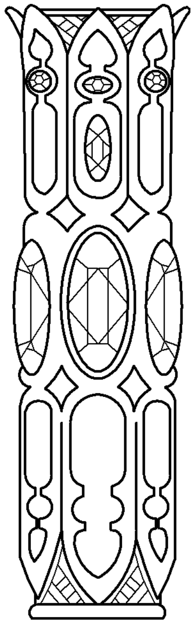


FIG. 19I

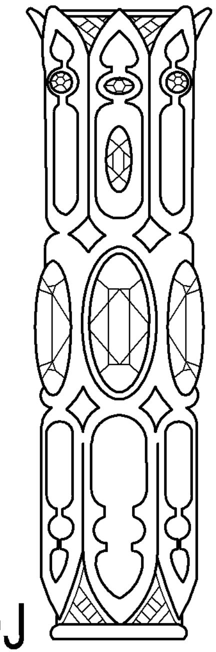


FIG. 19J

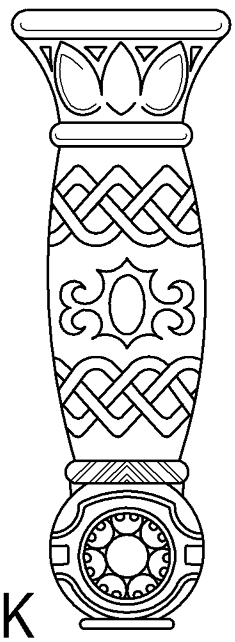


FIG. 19K

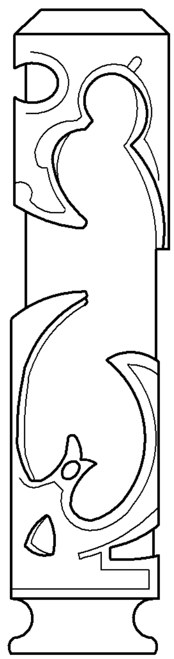


FIG. 19L

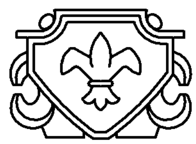


FIG. 19M

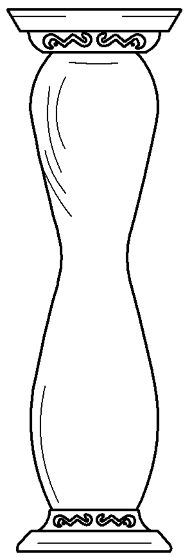


FIG. 19N

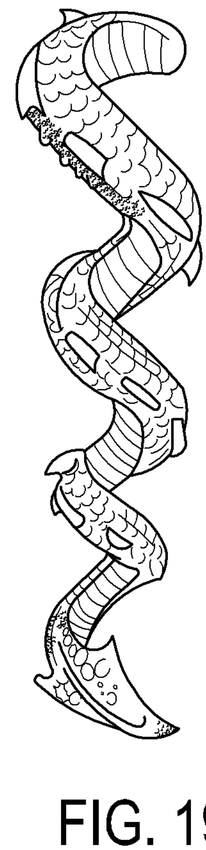


FIG. 19O

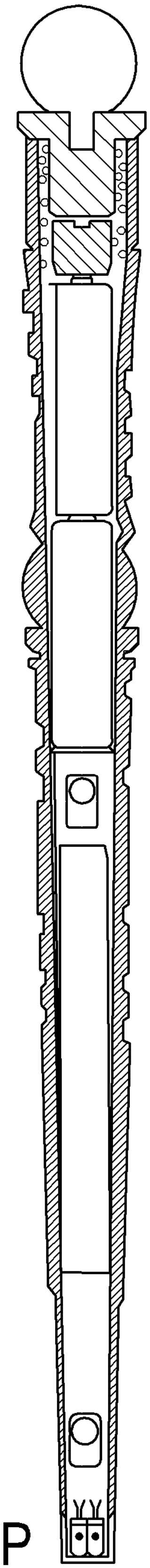


FIG. 19P

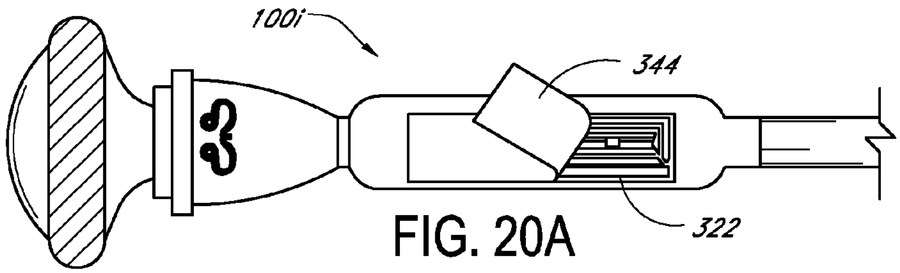


FIG. 20A

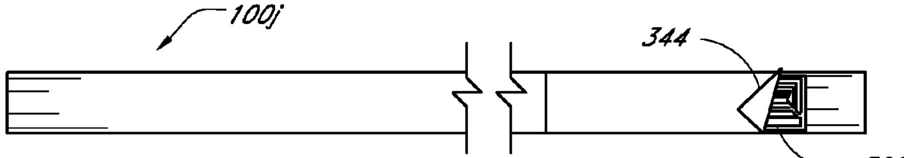


FIG. 20B

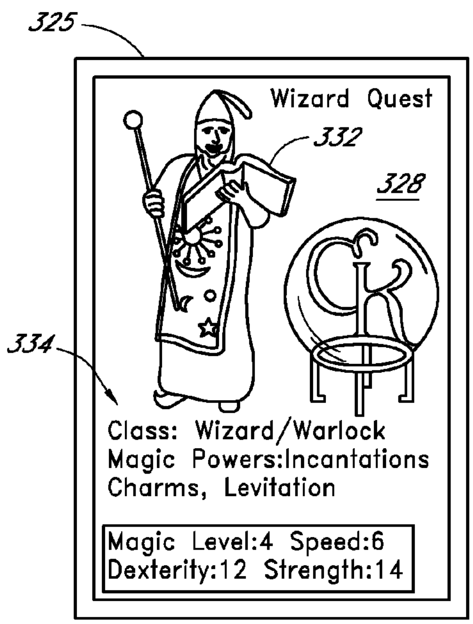


FIG. 20C

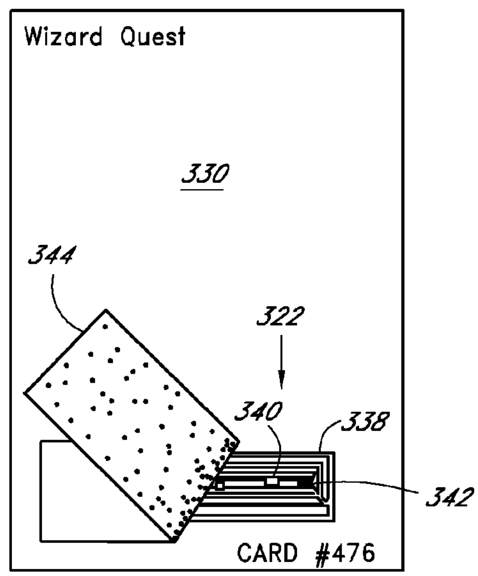


FIG. 20D

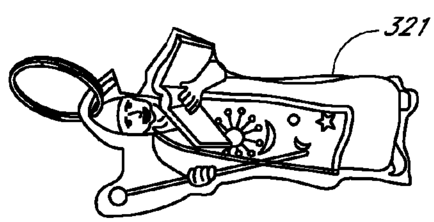


FIG. 20E

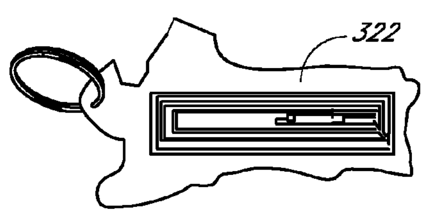


FIG. 20F

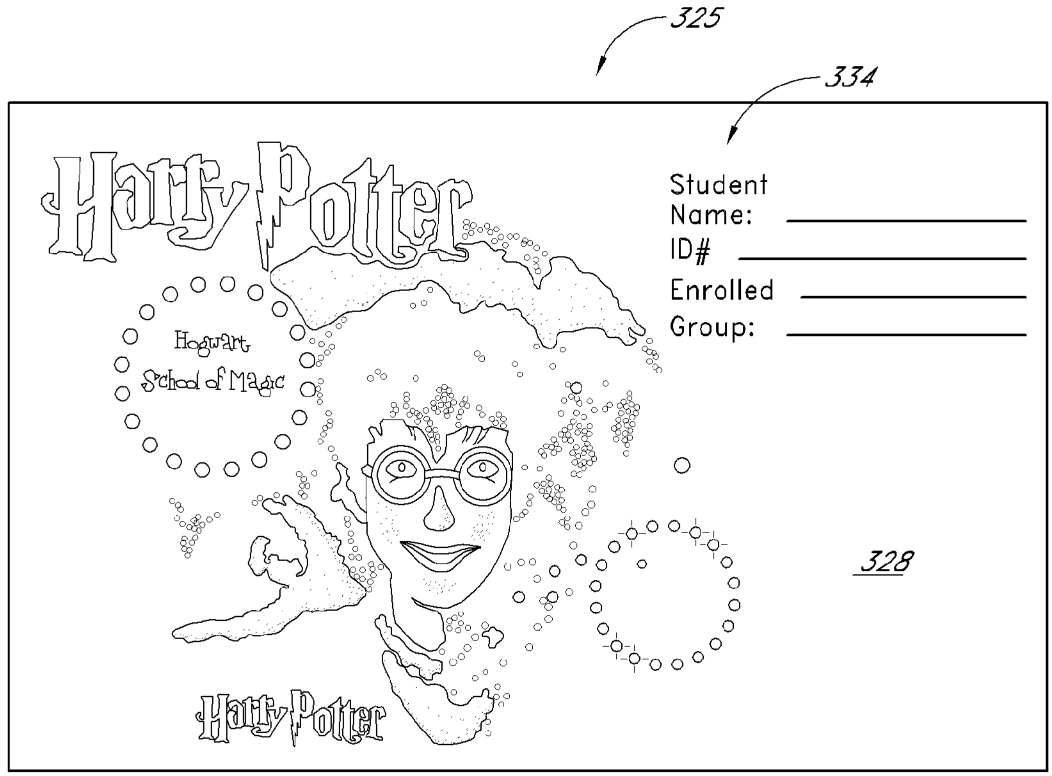


FIG. 20G

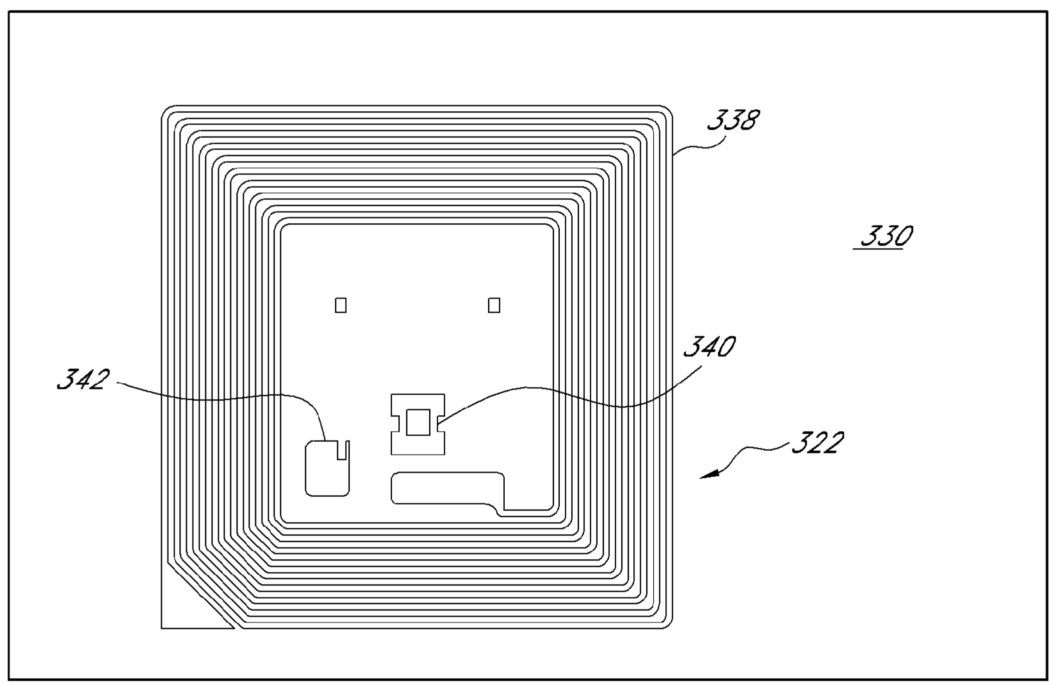


FIG. 20H

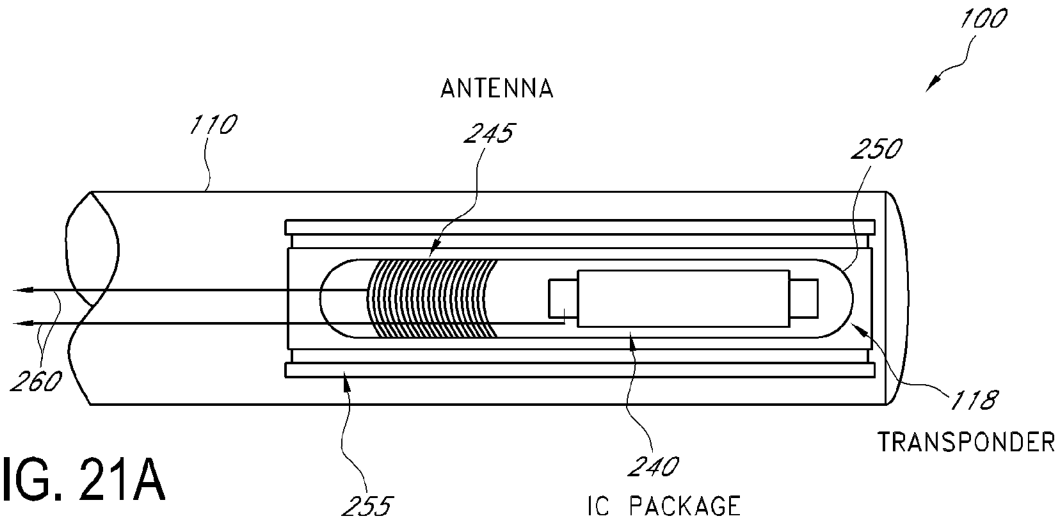


FIG. 21A

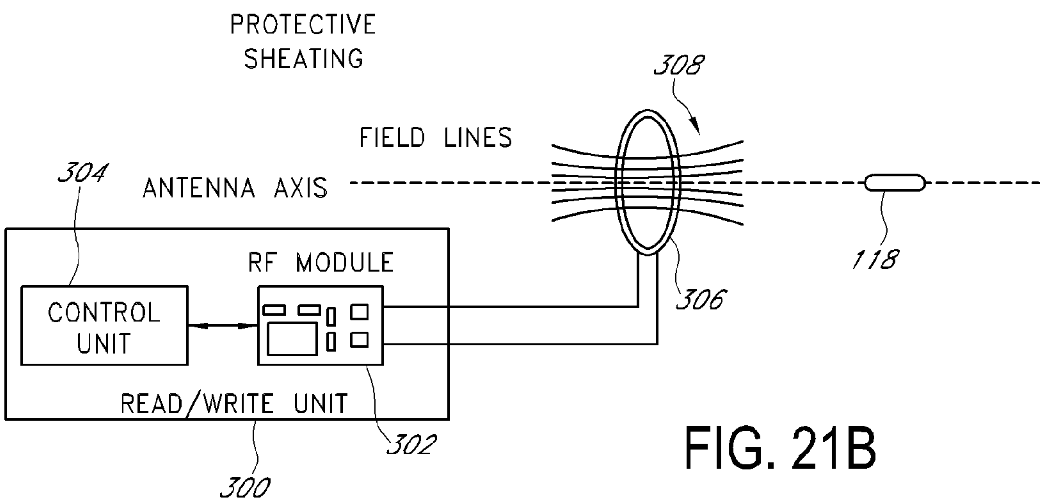


FIG. 21B

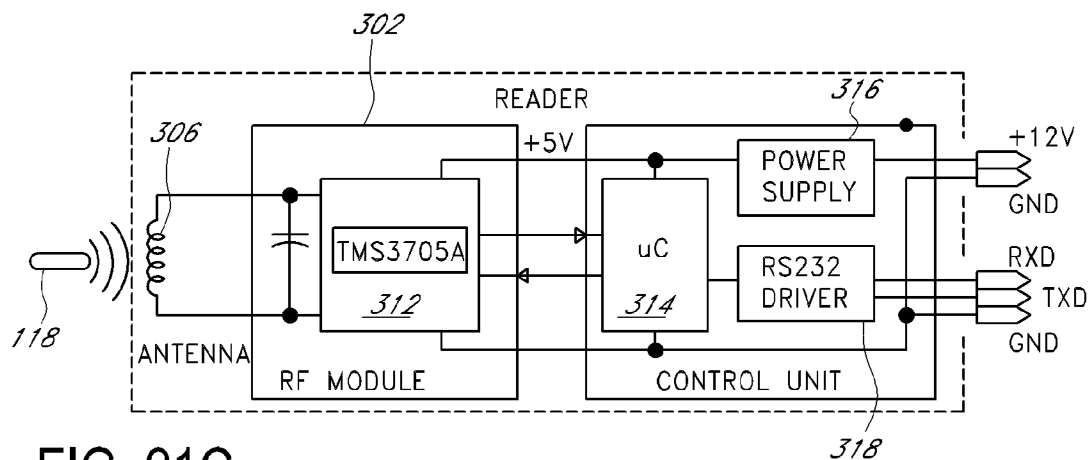


FIG. 21C

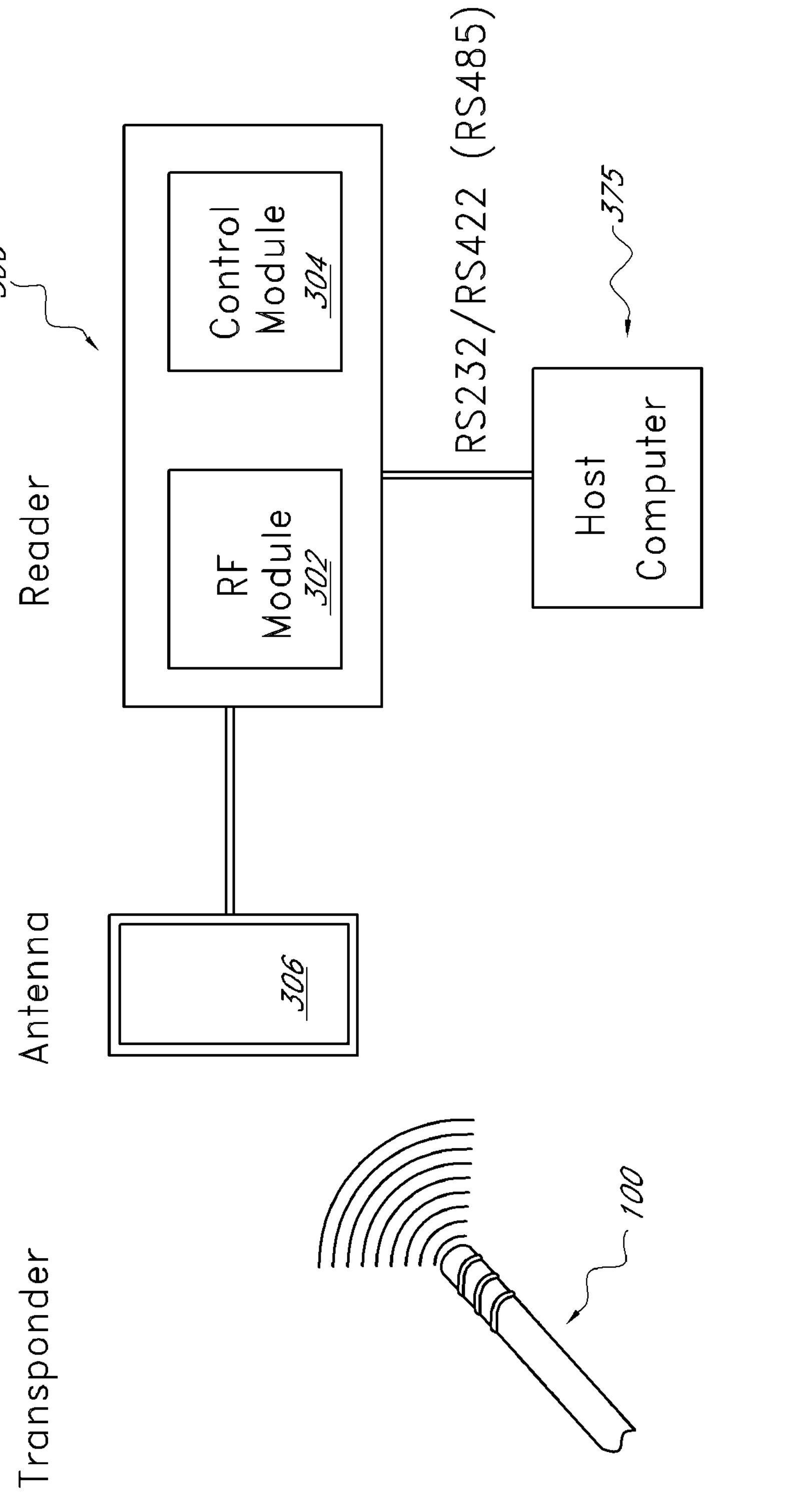

Transponder
100
Antenna
306
Reader
300
RF Module 302
Control Module 304
RS232/RS422 (RS485)
375
Host Computer

FIG. 21D

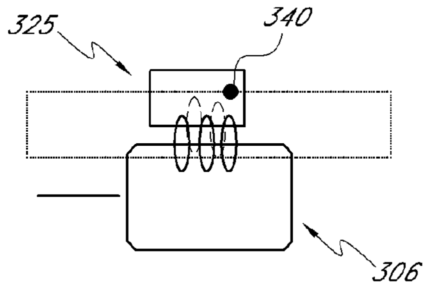


FIG. 21E

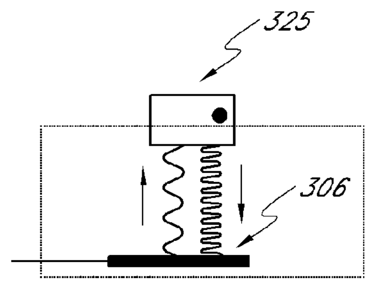


FIG. 21F

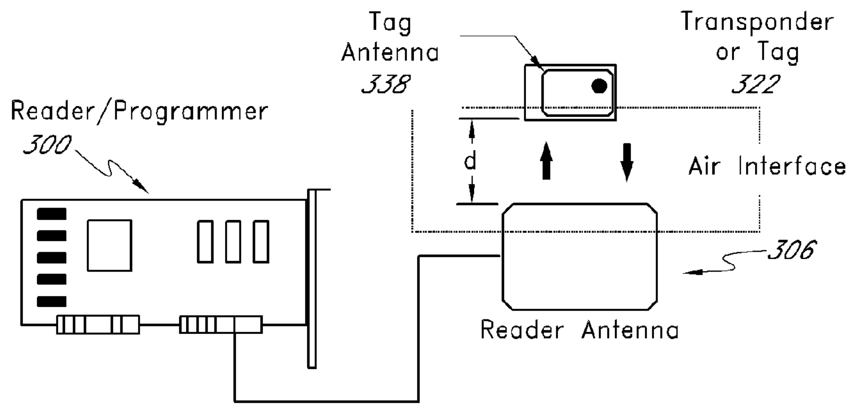


FIG. 21G

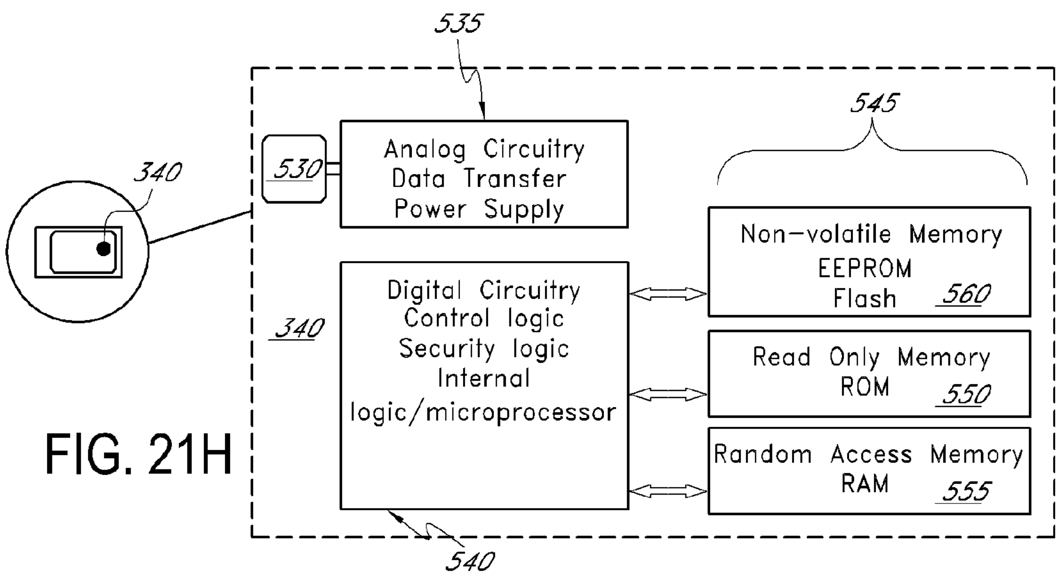


FIG. 21H

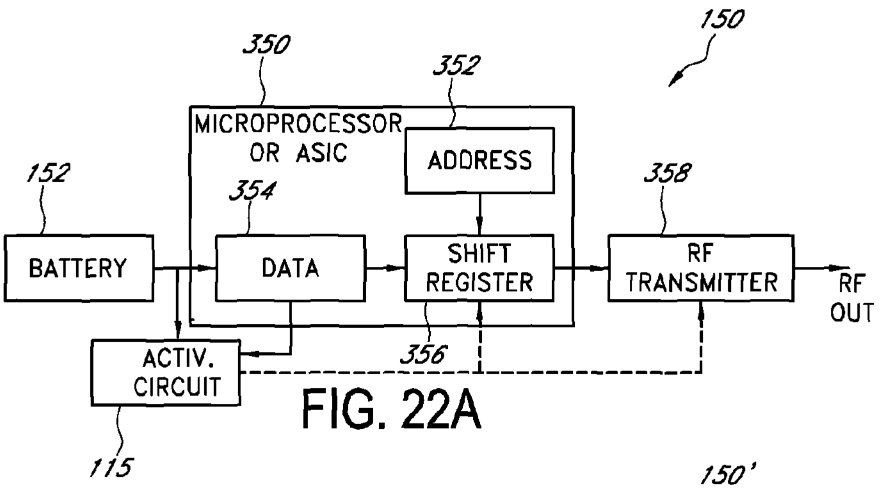


FIG. 22A

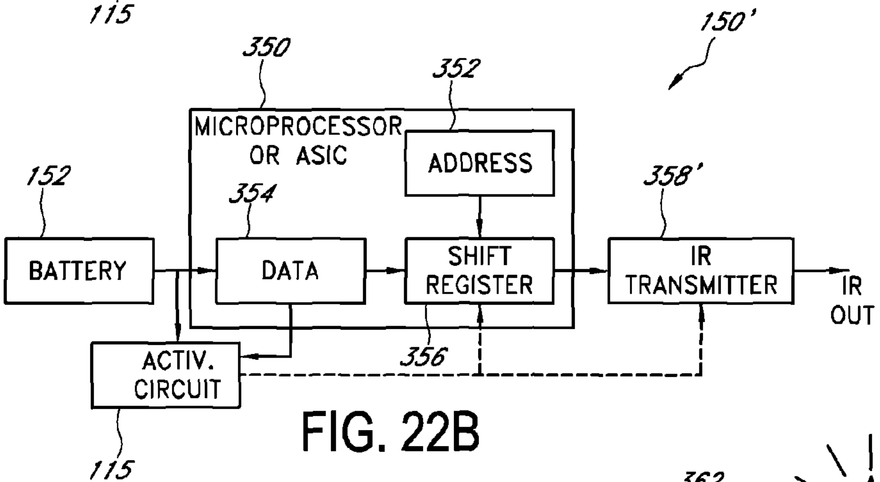


FIG. 22B

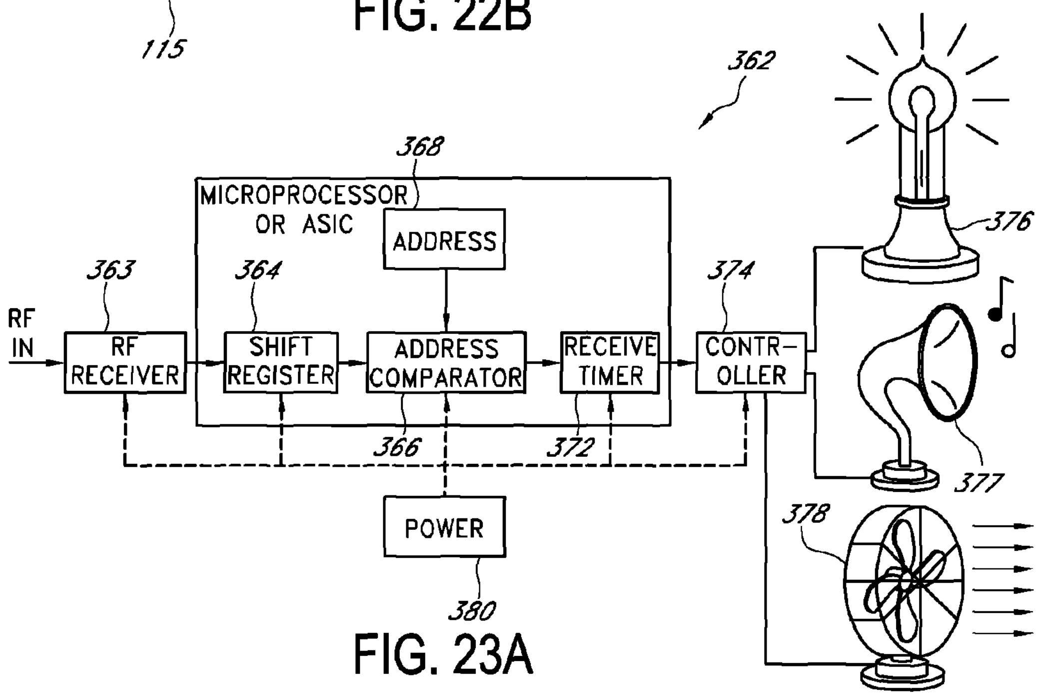


FIG. 23A

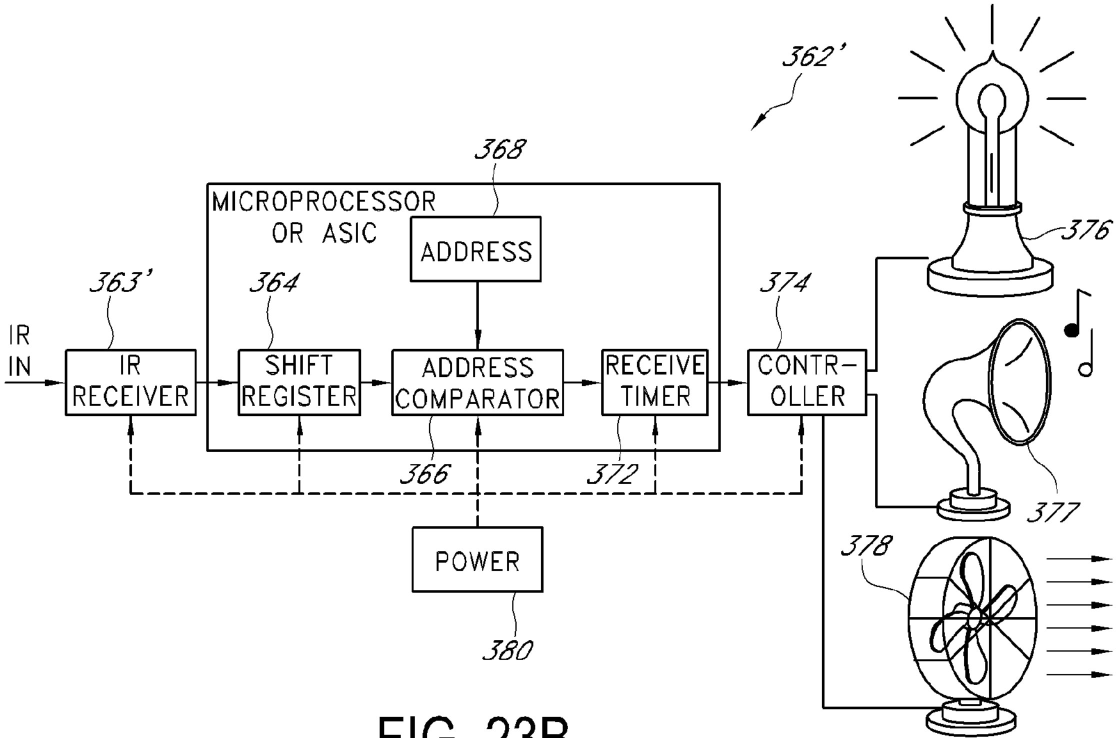


FIG. 23B

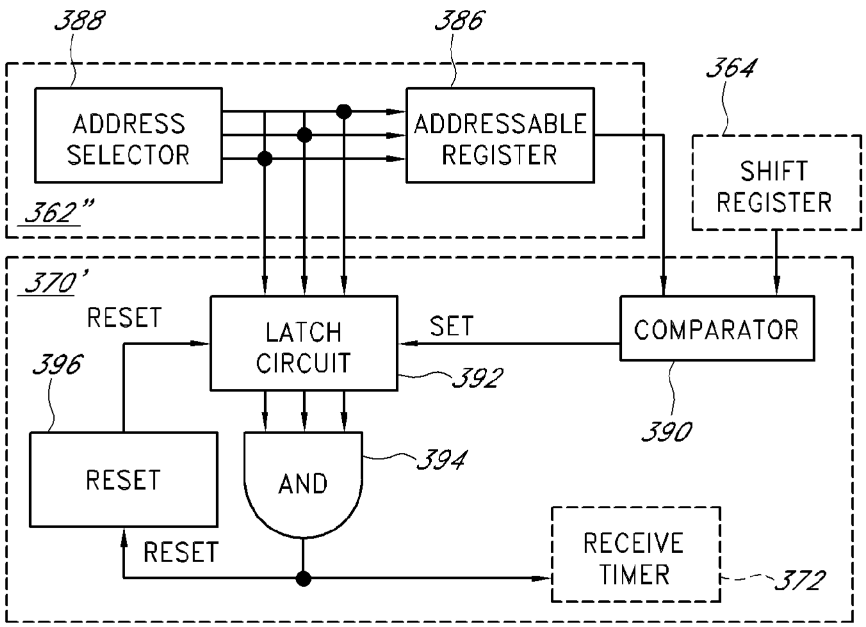


FIG. 24

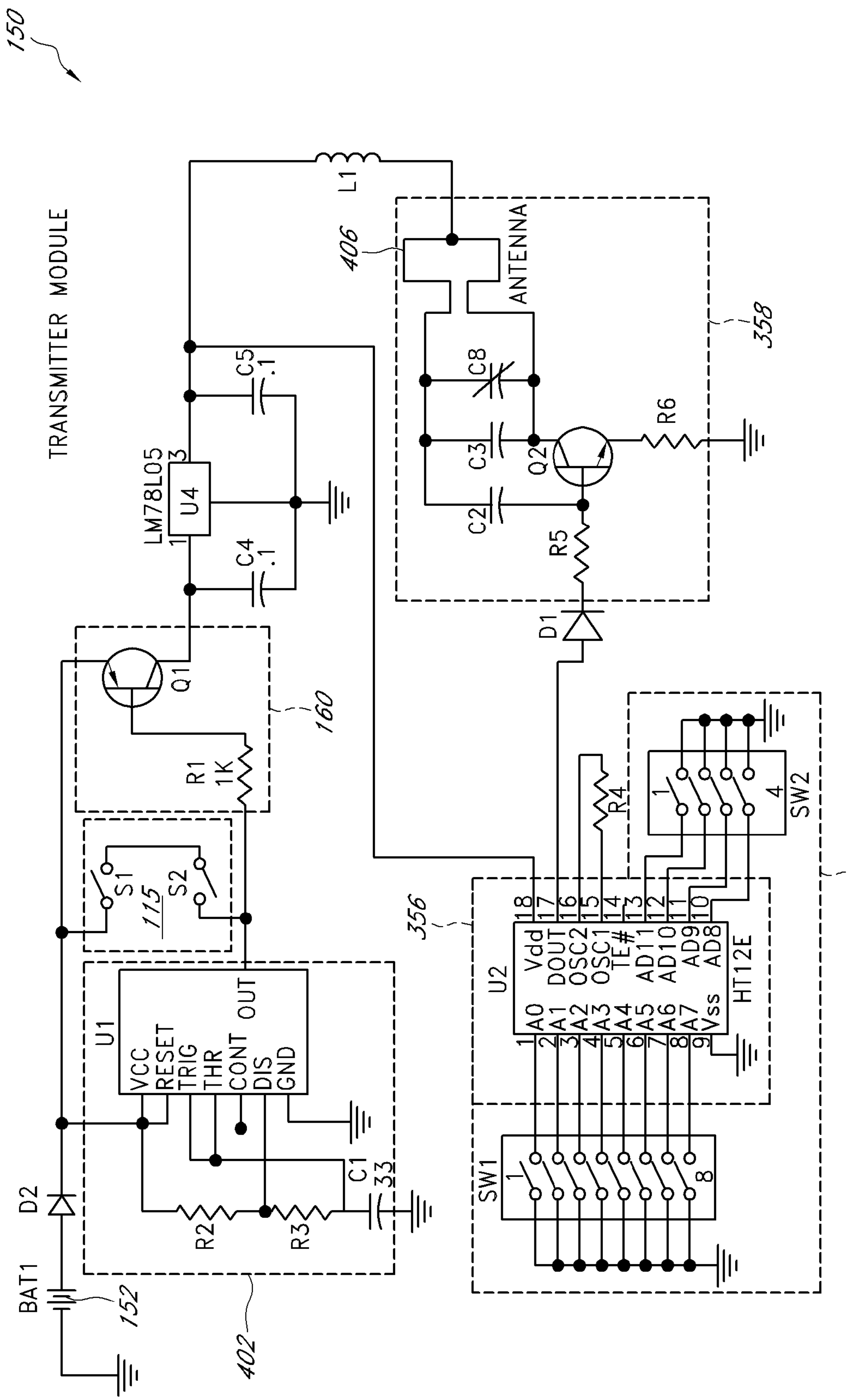

150
TRANSMITTER MODULE
L1
406
ANTENNA
358
C5
.1
C8
C3
Q2
R6
LM78L05
3
U4
1
C4
.1
C2
R5
D1
Q1
160
R1
1K
R4
SW2
4
S1
115
S2
356
352
U1
VCC
RESET
TRIG
THR
CONT
DIS
GND
OUT
U2
Vdd
DOUT
OSC2
OSC1
TE#
AD11
AD10
AD9
AD8
HT12E
A0
A1
A2
A3
A4
A5
A6
A7
Vss
D2
C1
33
SW1
8
BAT1
152
R2
R3
402

FIG. 25

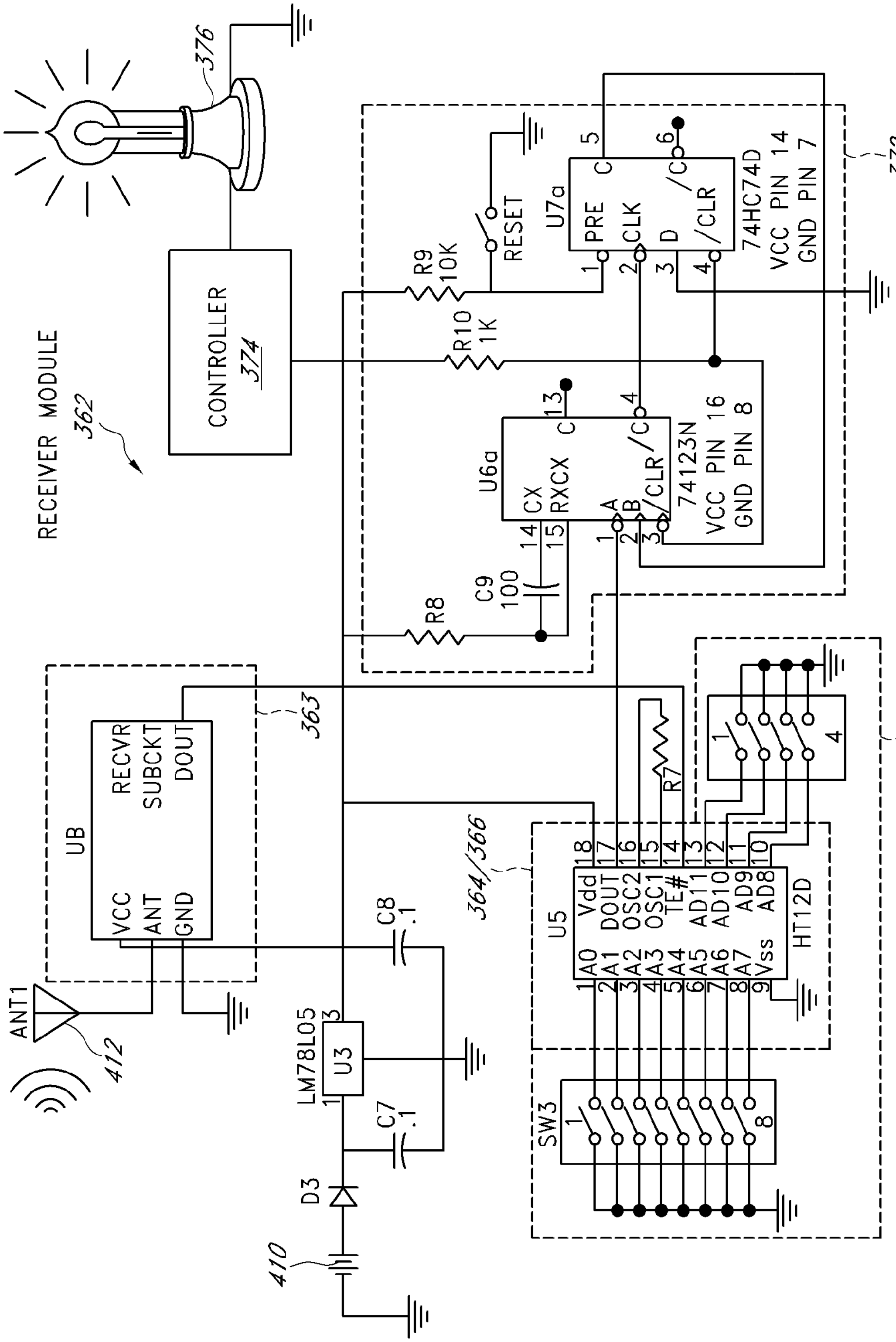

RECEIVER MODULE
362
376
CONTROLLER
374
R9
10K
RESET
U7a
PRE
CLK
D
/CLR
C
/C
74HC74D
VCC PIN 14
GND PIN 7
372
R10
1K
U6a
CX
RXCX
A
B
/CLR
/C
C
74123N
VCC PIN 16
GND PIN 8
C9
100
R8
UB
RECVR
SUBCKT
DOUT
VCC
ANT
GND
363
ANT1
412
LM78L05
U3
C8
.1
C7
.1
D3
410
364/366
U5
Vdd
DOUT
OSC2
OSC1
TE#
AD11
AD10
AD9
AD8
A0
A1
A2
A3
A4
A5
A6
A7
Vss
HT12D
R7
368
SW3

FIG. 26

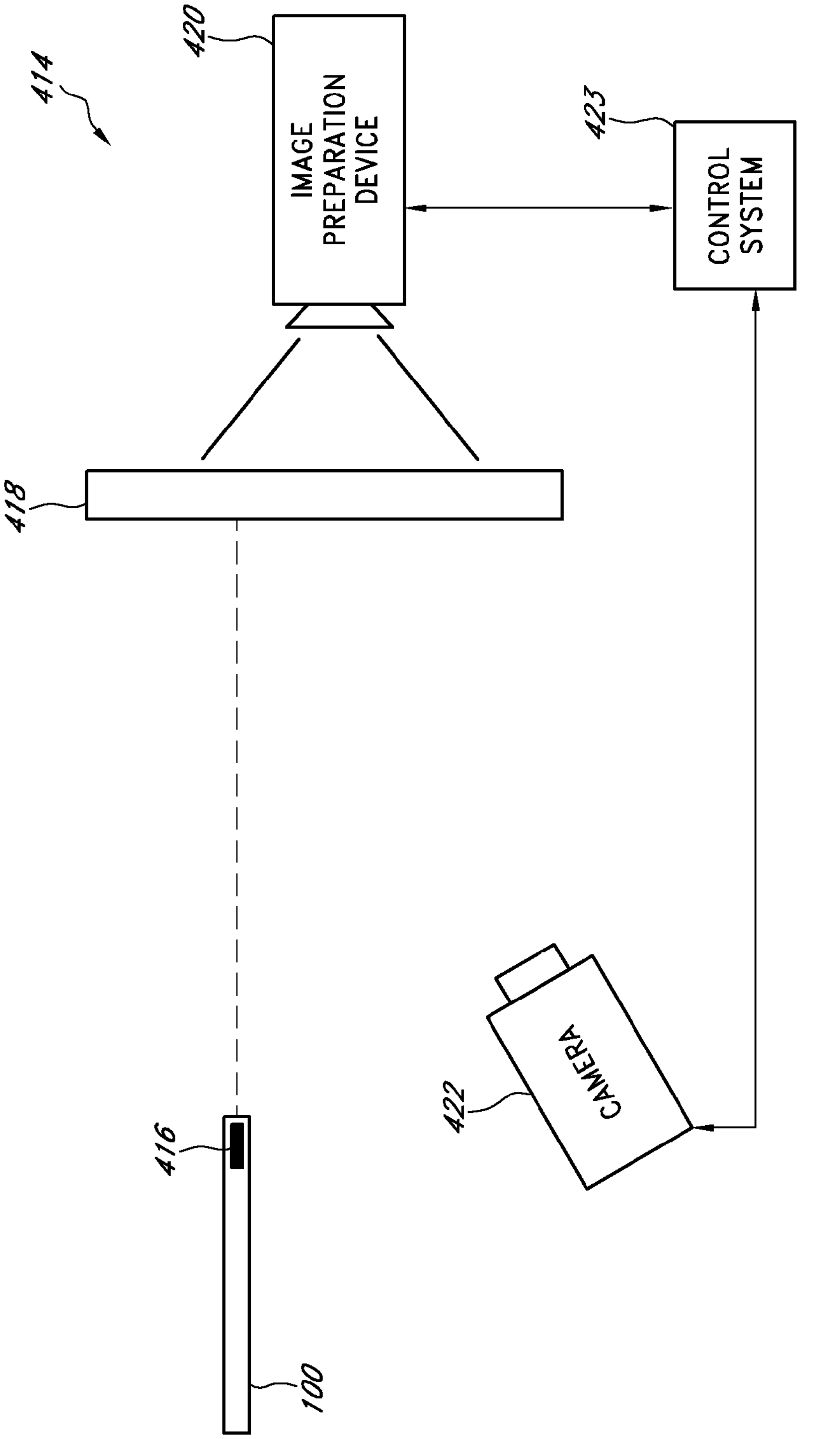

414
420
IMAGE
PREPARATION
DEVICE
423
CONTROL
SYSTEM
418
416
422
CAMERA
100

FIG. 27

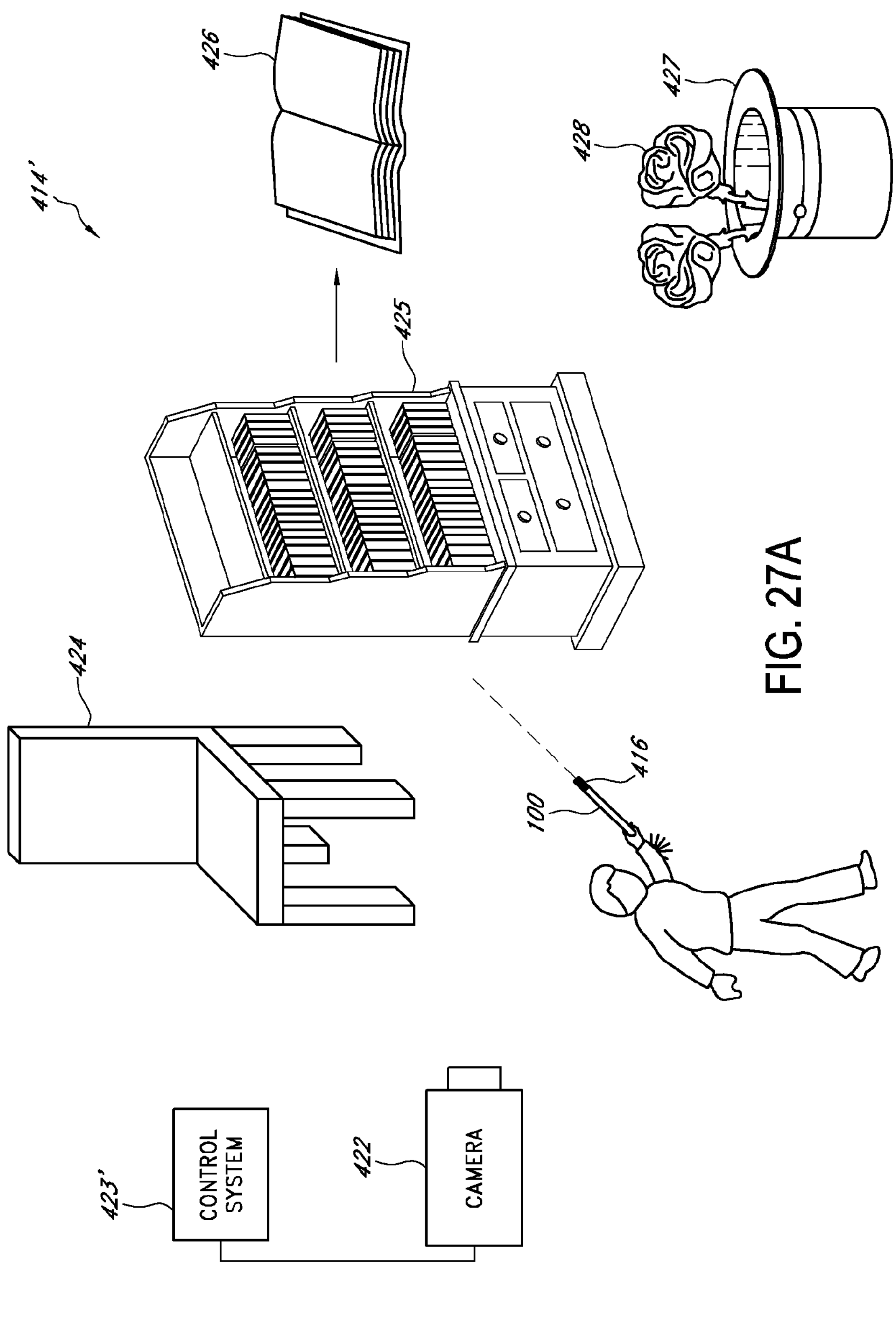


FIG. 27A

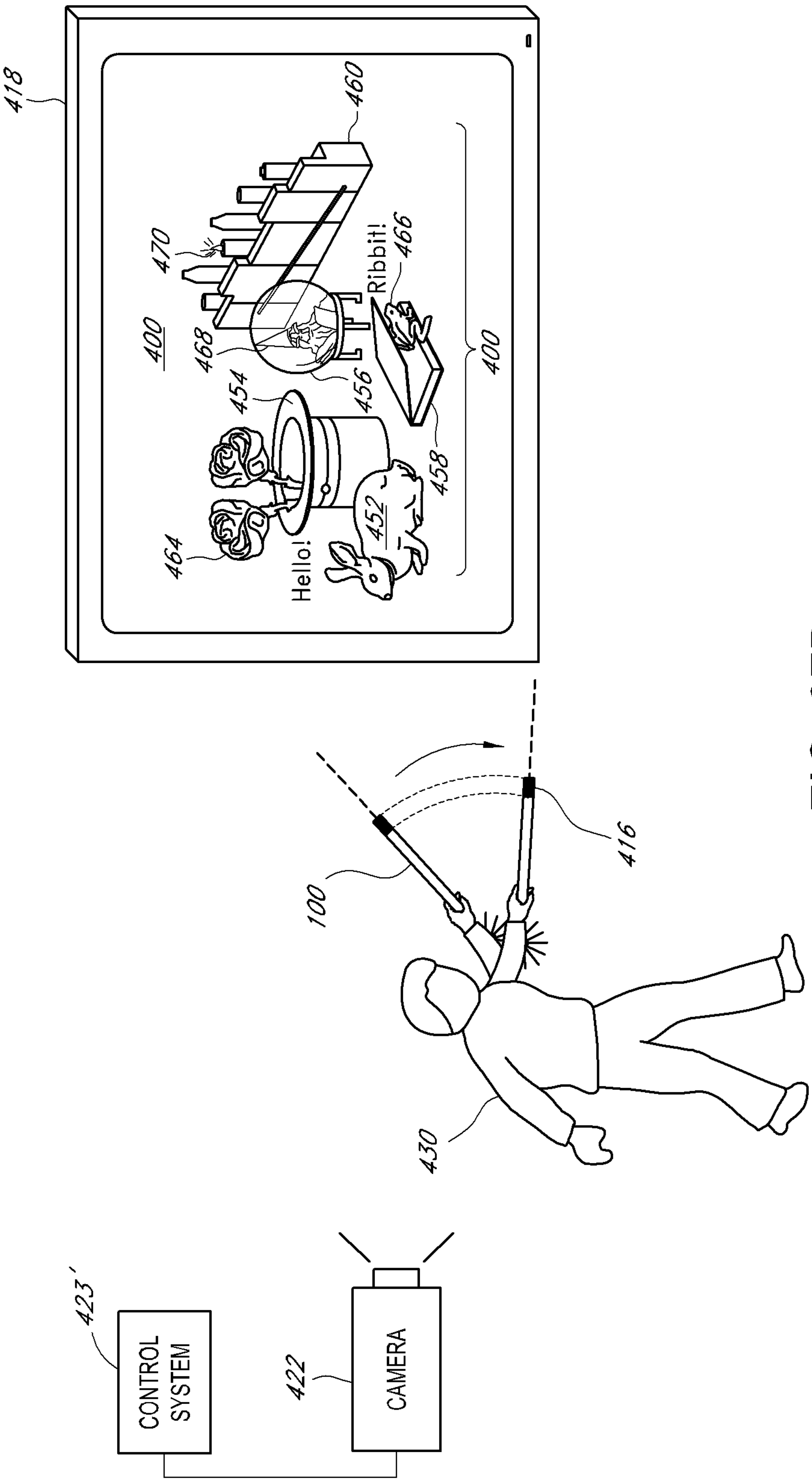

418
400
460
470
466
Ribbit!
468
454
456
458
452
464
Hello!
100
416
430
423'
CONTROL SYSTEM
422
CAMERA

FIG. 27B

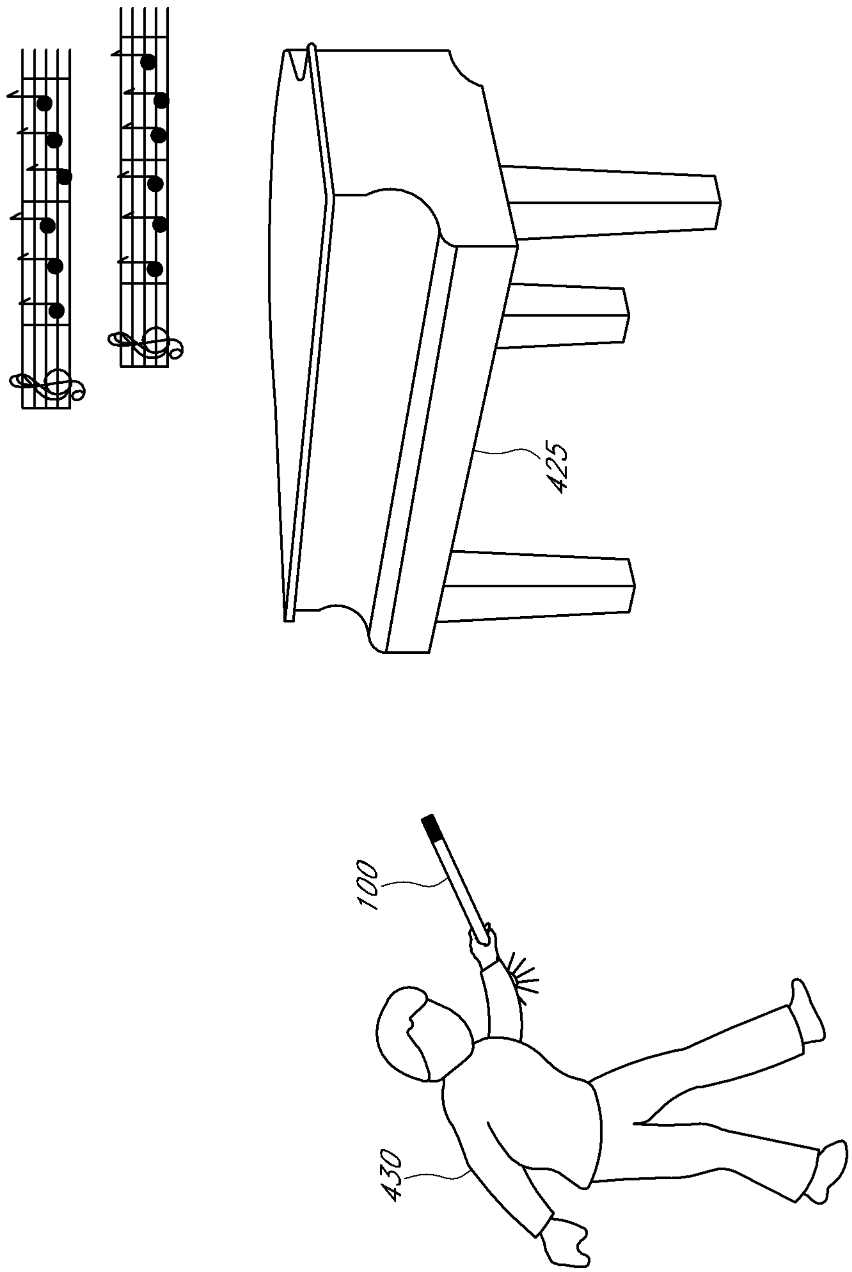


FIG. 28

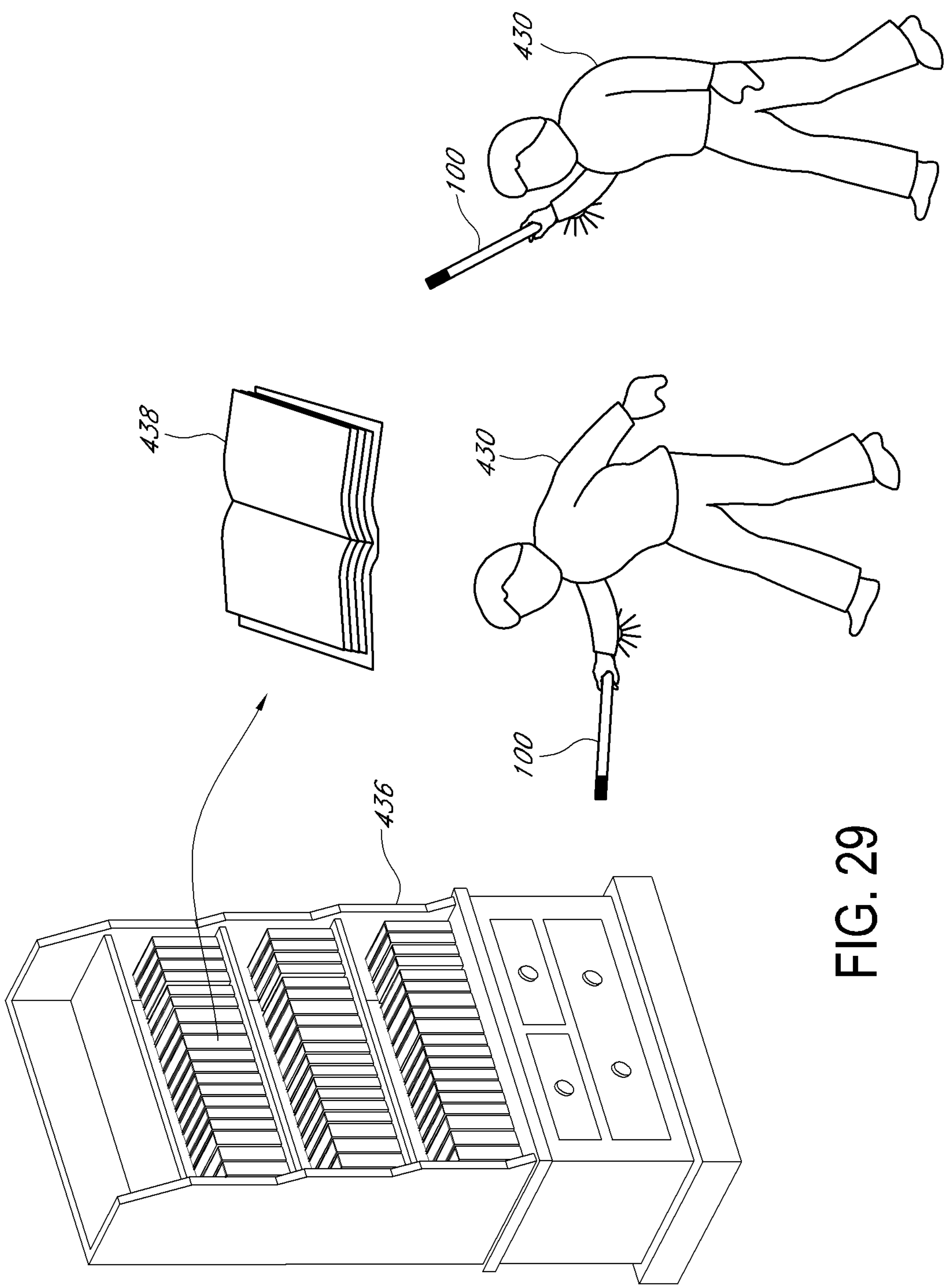


FIG. 29

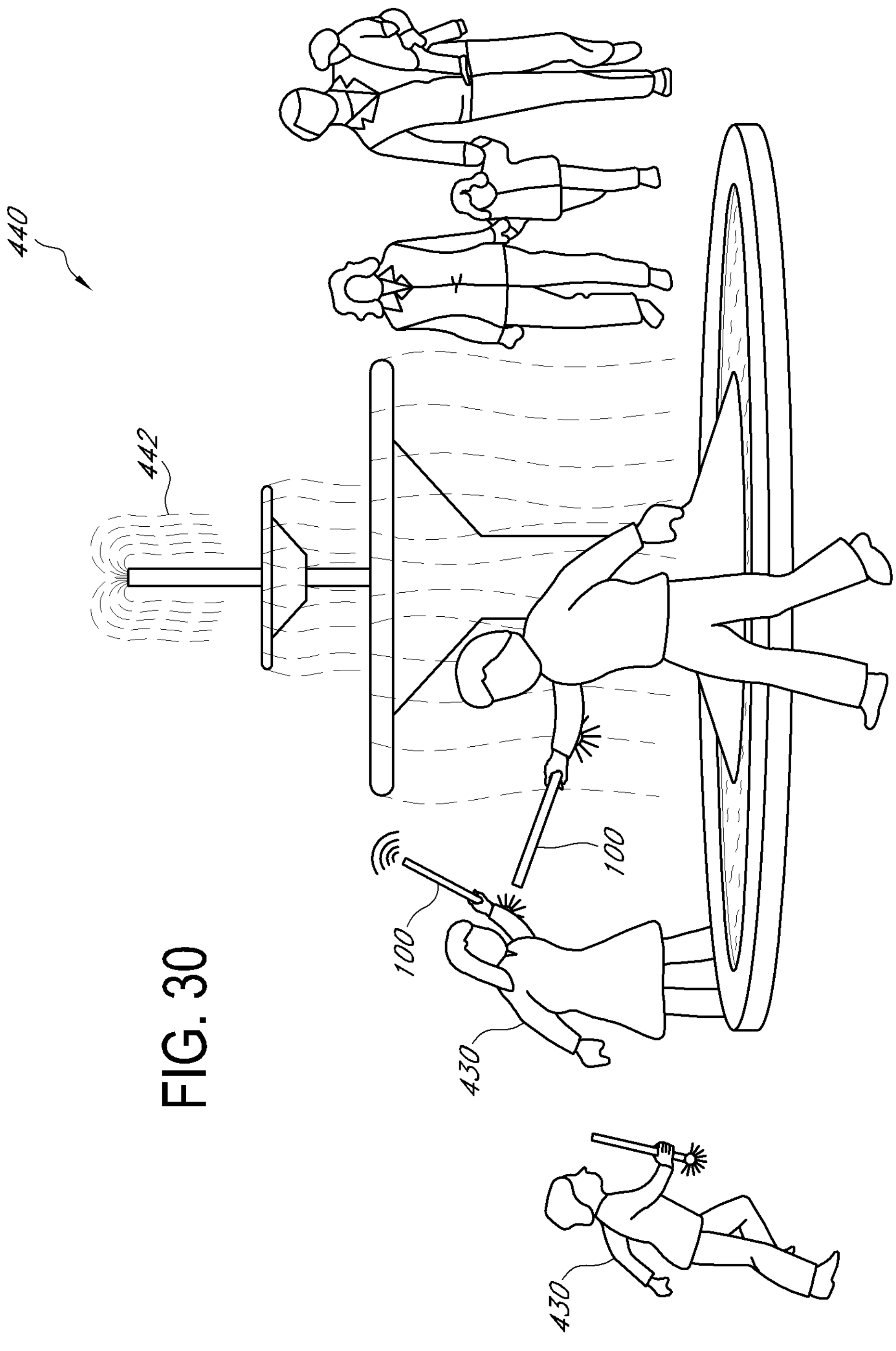


FIG. 30

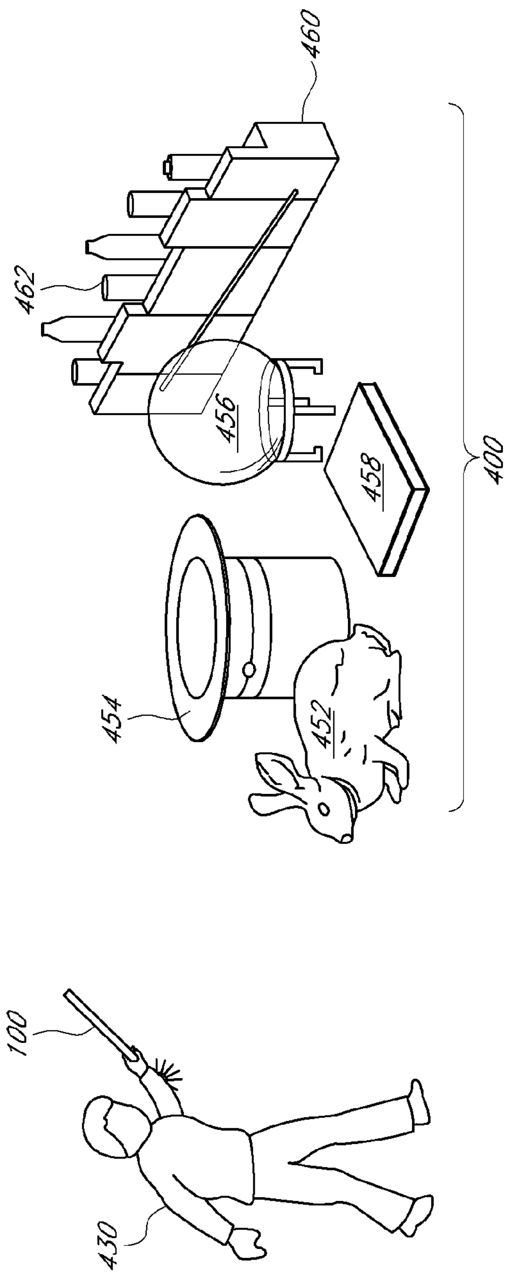


FIG. 31A

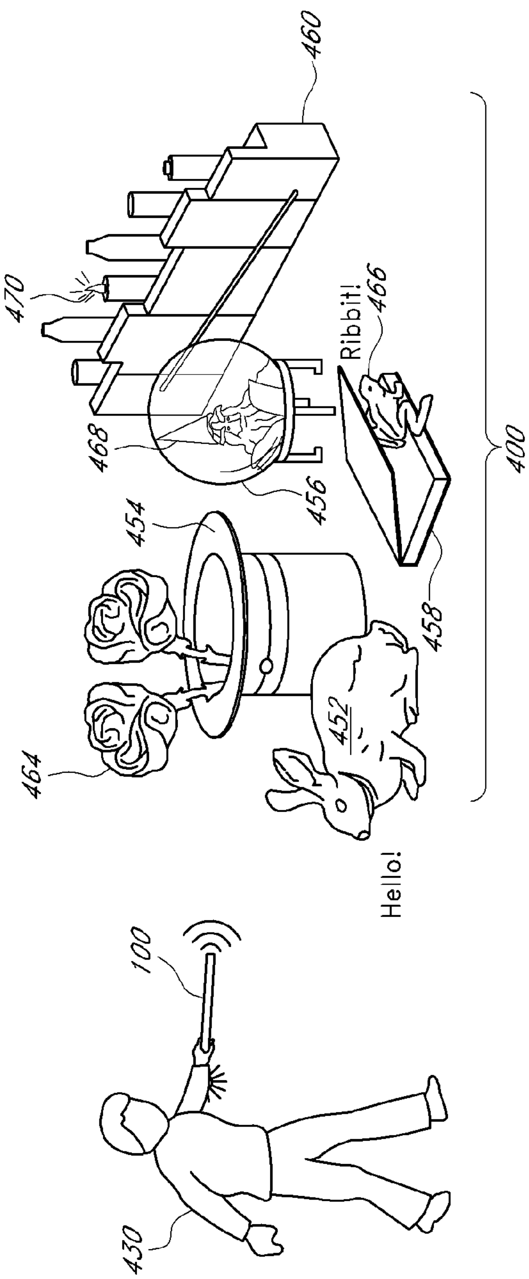


FIG. 31B

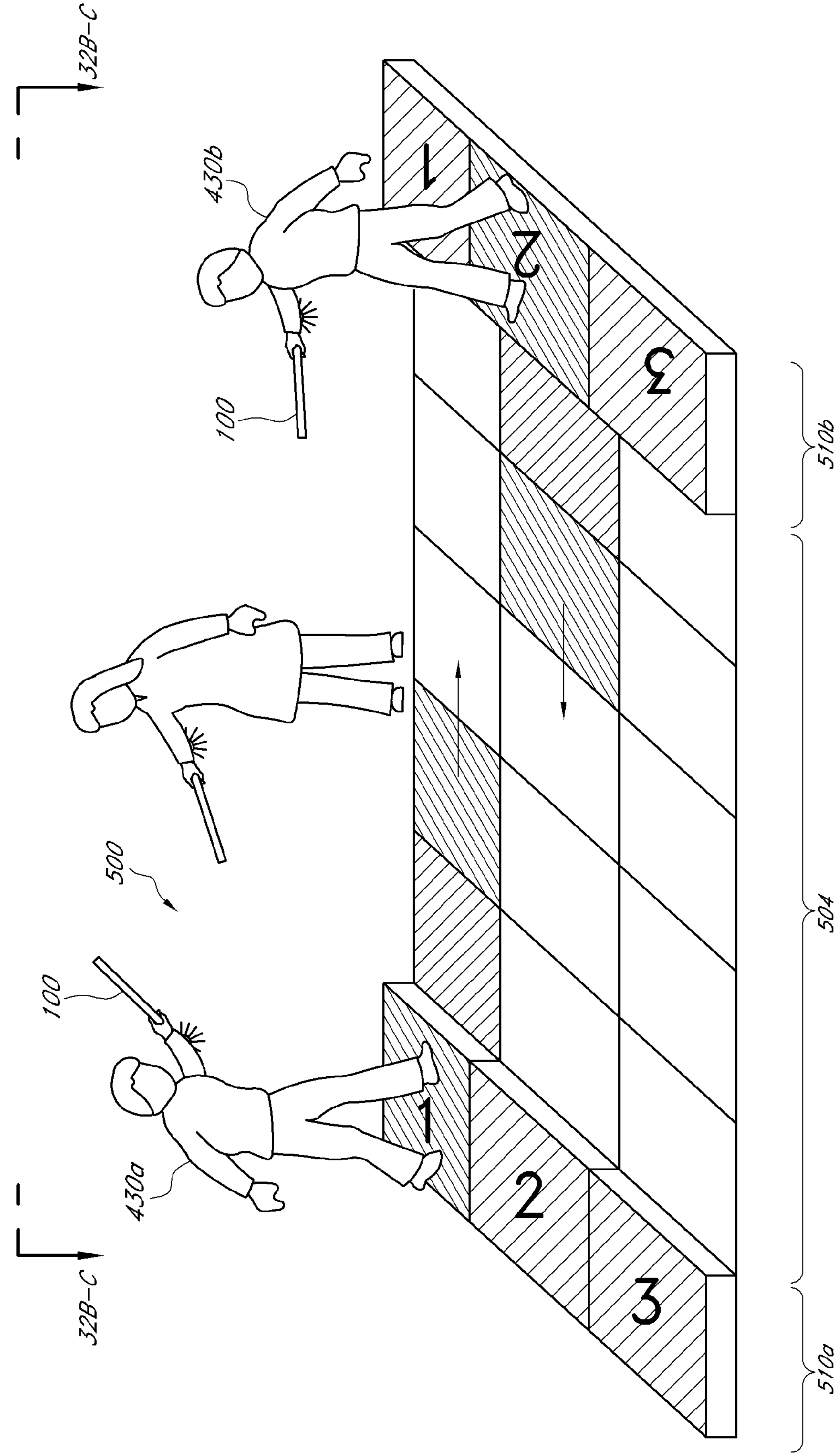


FIG. 32A

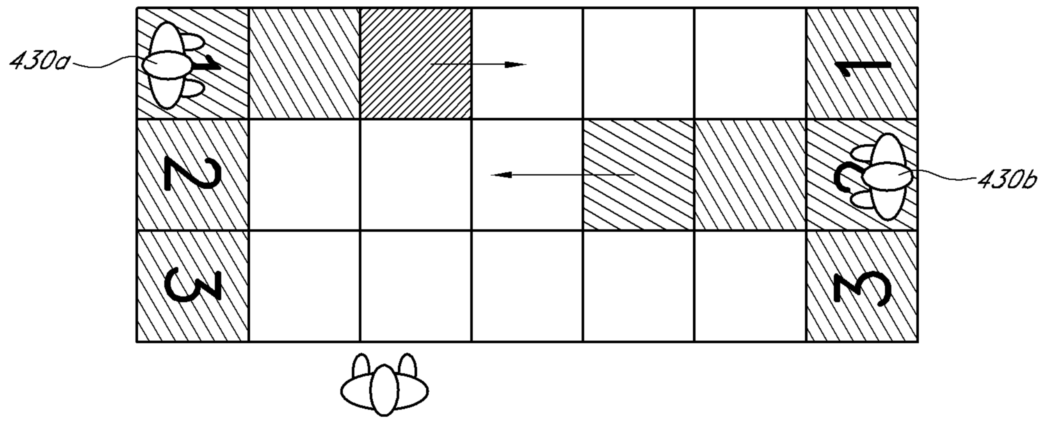


FIG. 32B

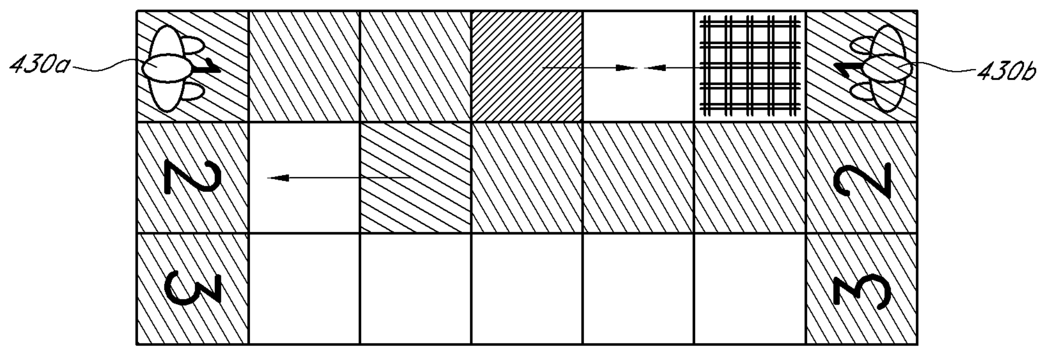


FIG. 32C

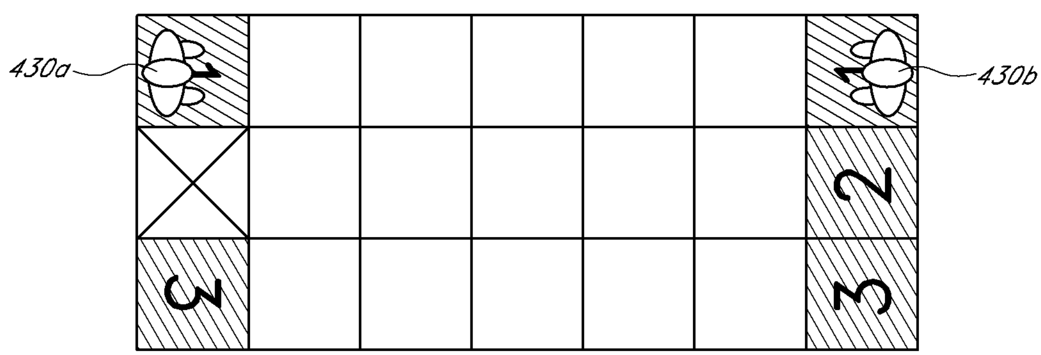


FIG. 32D

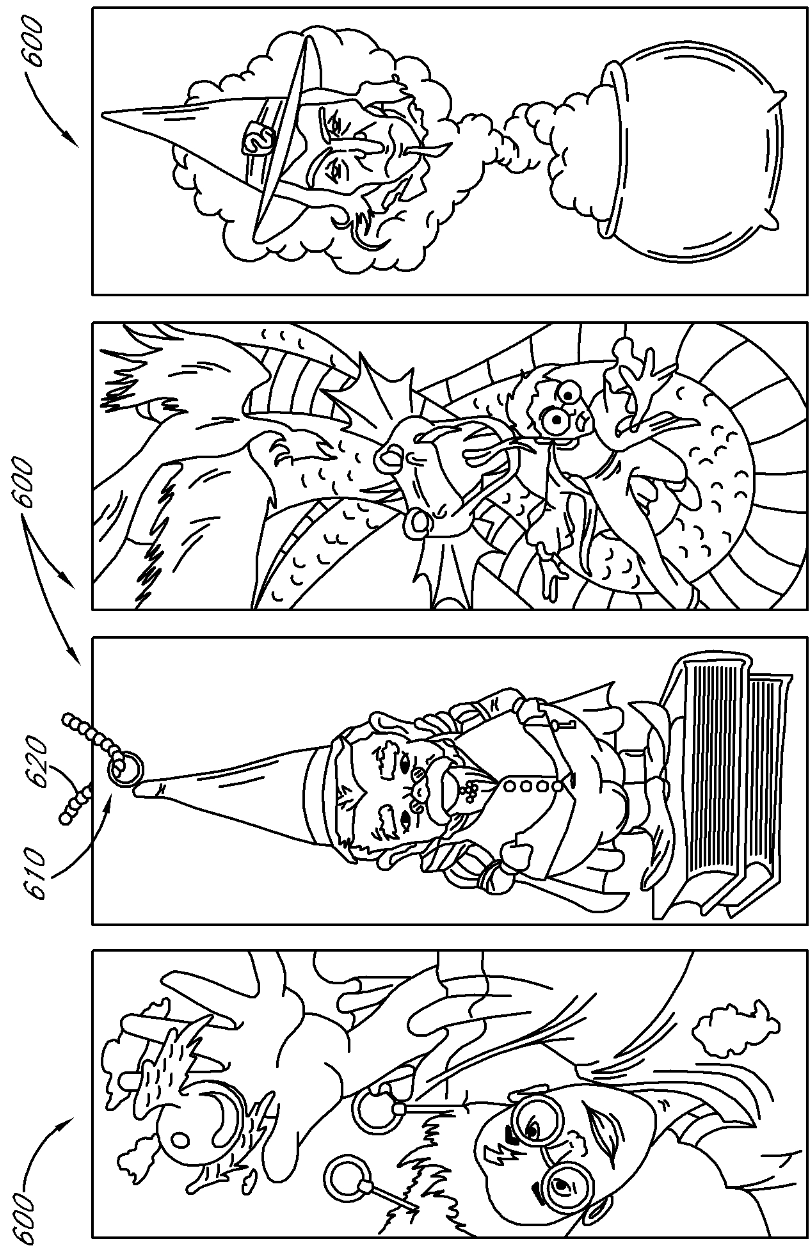


FIG. 33A

FIG. 33B

FIG. 33C

FIG. 33D

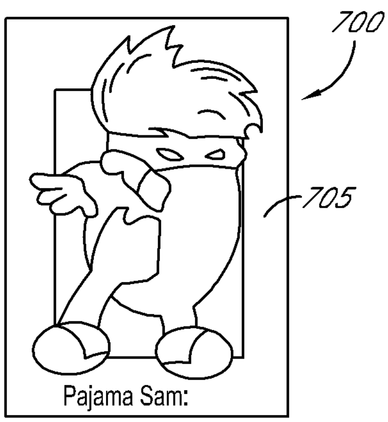
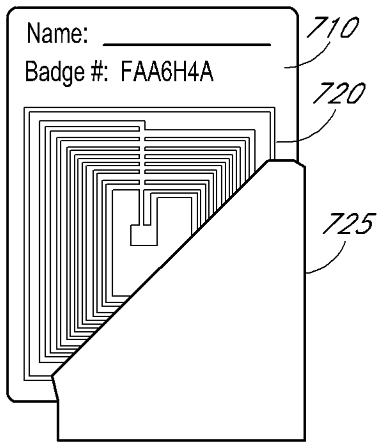


FIG. 34A

FIG. 34B



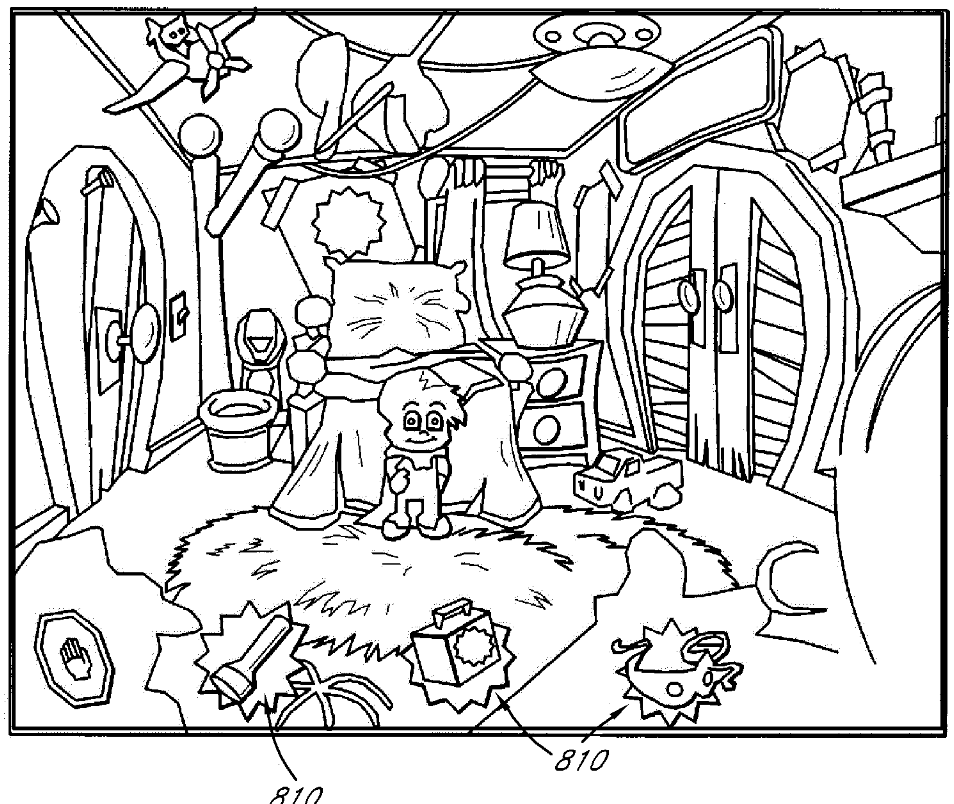


FIG. 35A

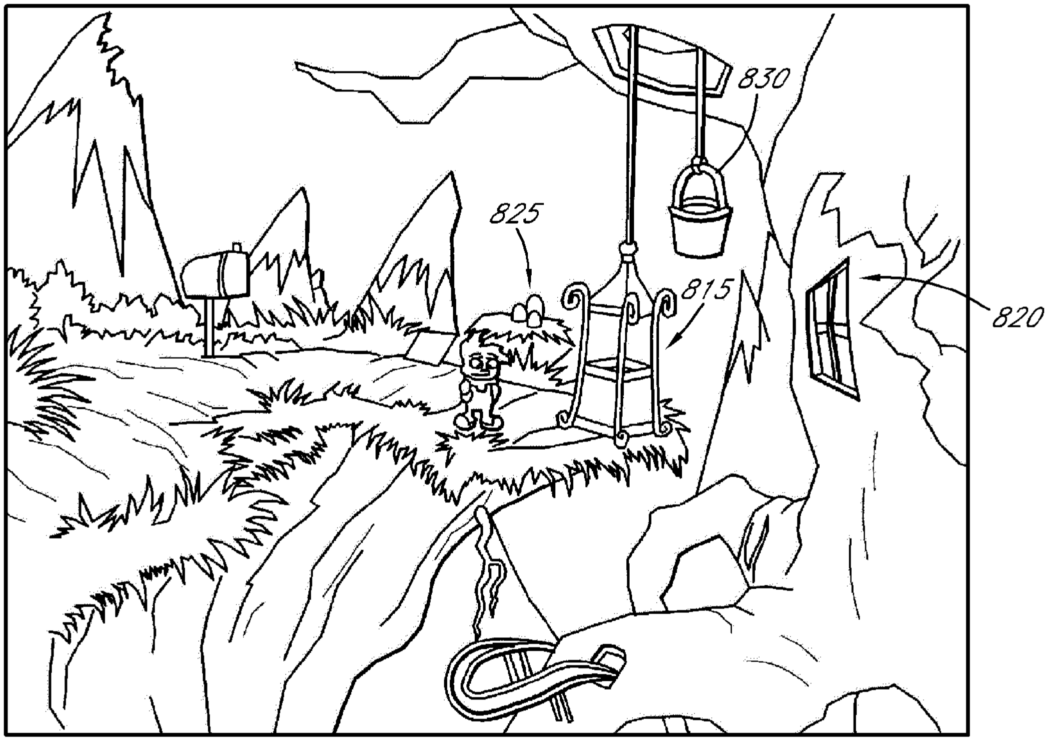


FIG. 35B

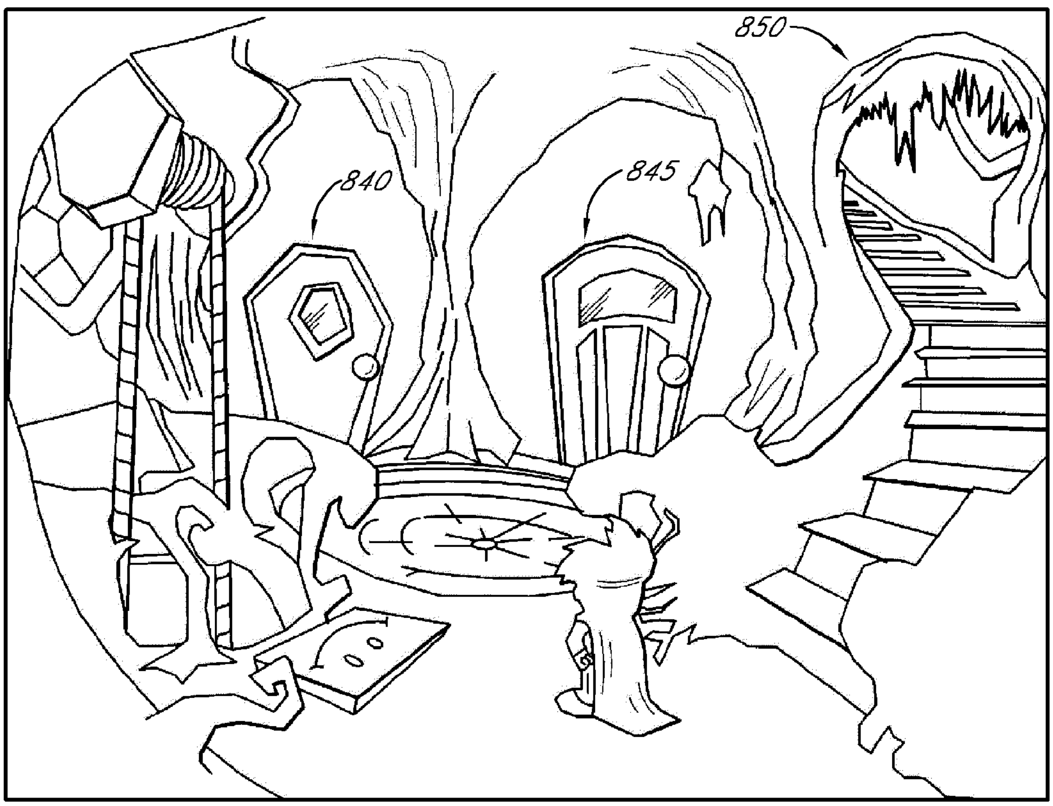


FIG. 35C

FIG. 35D

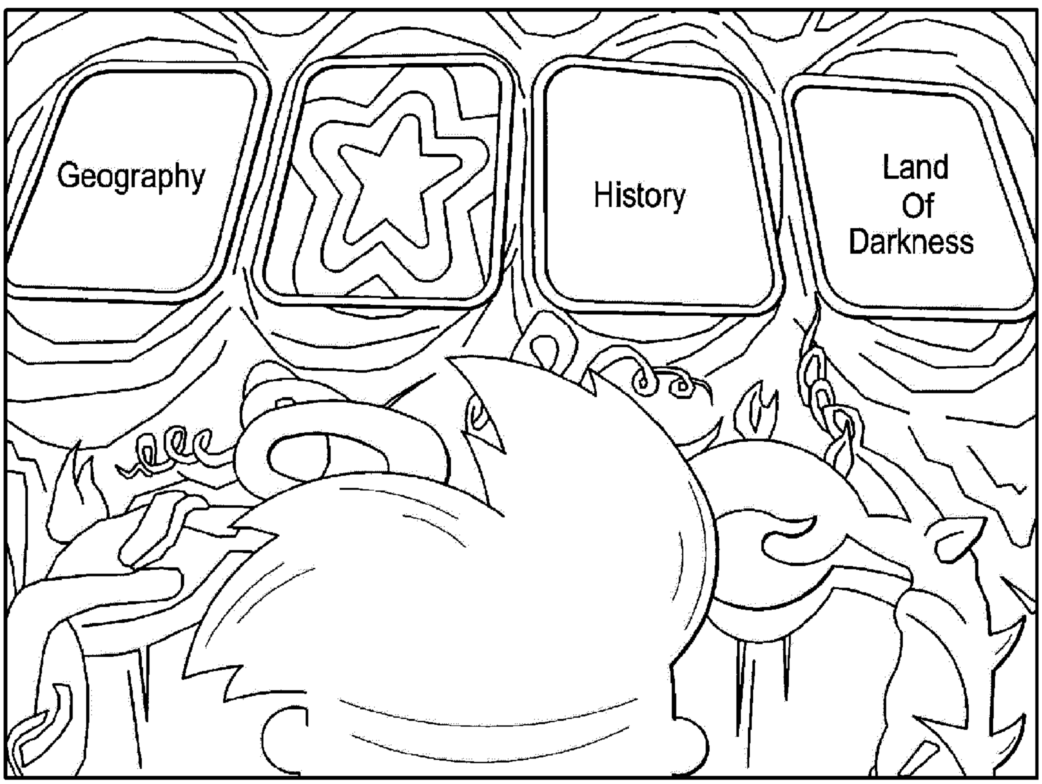


FIG. 35E

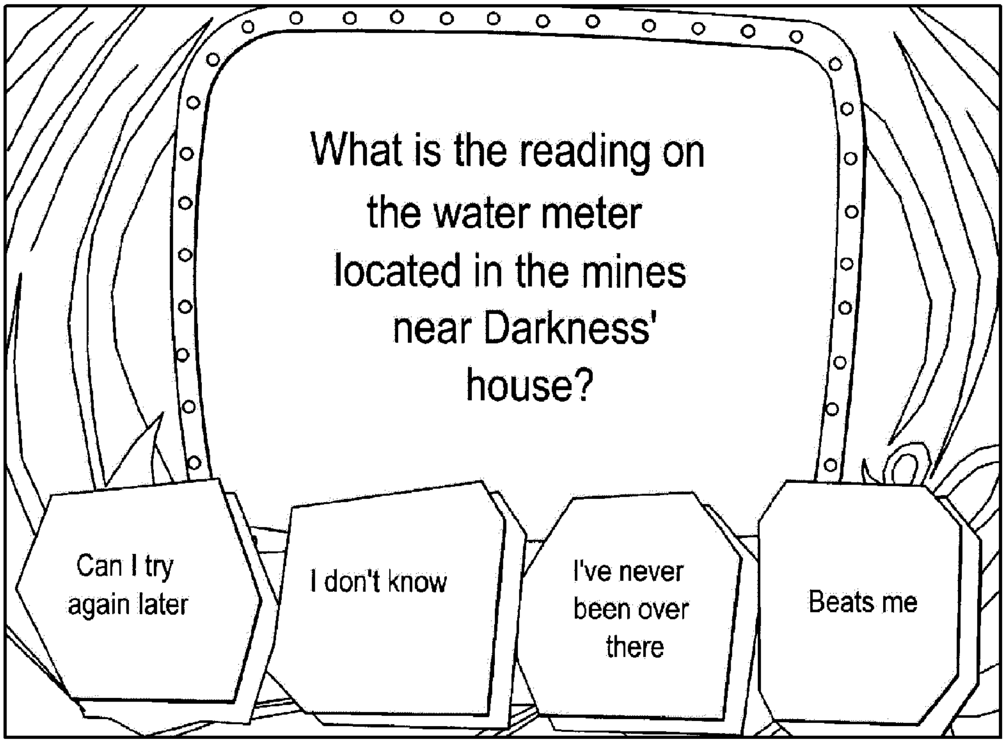


FIG. 35F

FIG. 35G

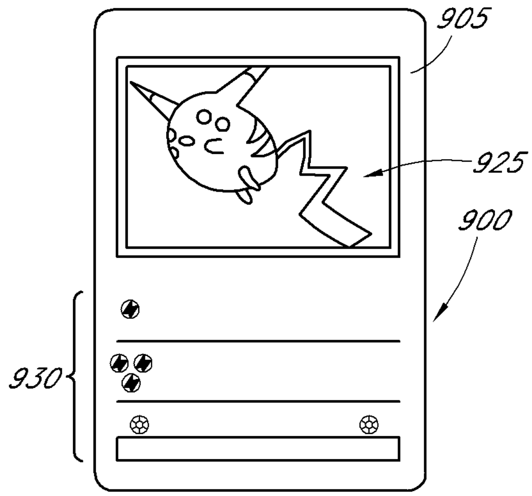


FIG. 36A

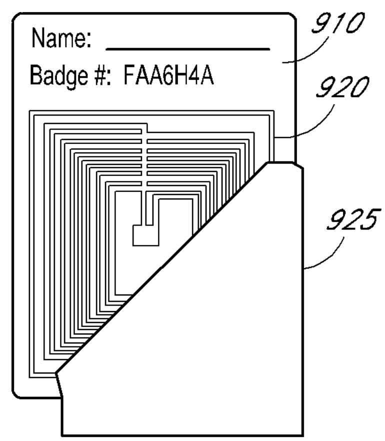


FIG. 36B

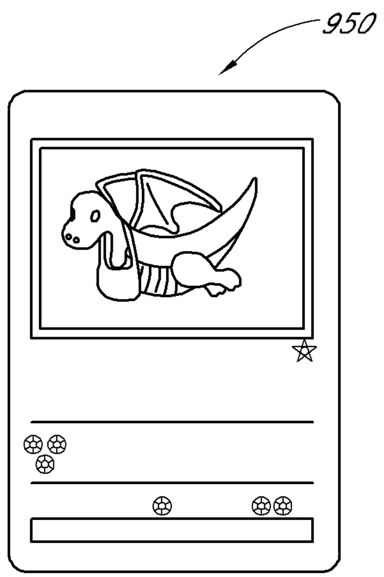


FIG. 36C

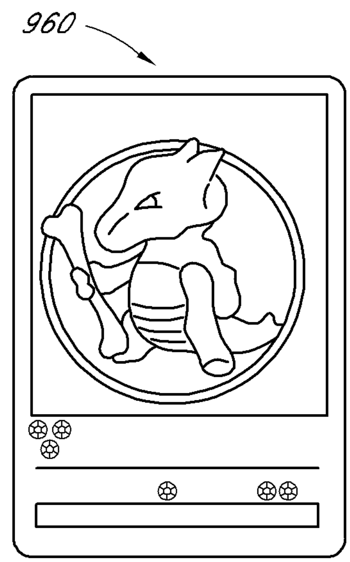


FIG. 36D

PORTABLE GAMING DEVICE AND GAMING SYSTEM COMBINING BOTH PHYSICAL AND VIRTUAL PLAY ELEMENTS

RELATED APPLICATIONS

The present application is a continuation of U.S. patent application Ser. No. 13/589,034, filed Aug. 17, 2012, now U.S. Pat. No. 8,384,668, which is a continuation of U.S. patent application Ser. No. 13/452,508, filed Apr. 20, 2012, now U.S. Pat. No. 8,248,367, which is a continuation of U.S. patent application Ser. No. 13/314,980, filed Dec. 8, 2011, now U.S. Pat. No. 8,164,567, which is a continuation of U.S. patent application Ser. No. 13/231,813, filed Sep. 13, 2011, now U.S. Pat. No. 8,169,406, which is a continuation of U.S. patent application Ser. No. 12/261,864, filed Oct. 30, 2008, now U.S. Pat. No. 8,089,458 which is a divisional of U.S. patent application Ser. No. 10/954,025, filed Sep. 29, 2004, now U.S. Pat. No. 7,445,550, which is a continuation-in-part of U.S. patent application Ser. No. 10/397,054, filed Mar. 25, 2003, now U.S. Pat. No. 7,500,917, which is a continuation-in-part of U.S. patent application Ser. No. 09/792,282, filed Feb. 22, 2001, now U.S. Pat. No. 6,761,637, each of which is hereby incorporated herein by reference in its entirety to be part of this specification.

BACKGROUND

1. Field

The present invention generally relates to children's games and, in particular, to magic wands and interactive games and play systems utilizing wireless transponders and receivers for providing a magical interactive play experience. The present invention also relates particularly to interactive toys, games and play systems utilizing radio frequency transponders and transceivers to provide a unique interactive game play experience.

2. Description of the Related Art

Games, toys, play structures and other similar entertainment systems are well known for providing play and interaction among children and adults. A variety of commercially available play toys and games are also known for providing valuable learning and entertainment opportunities for children, such as role playing, reading, memory stimulation, tactile coordination and the like.

Magic and wizardry are classic play themes that continue to capture imaginations and entertain new generations of children and adults alike. Magic and the seemingly limitless possibilities of fun and exciting things brought to life through magic challenge children's imaginations, creativity and social interactivity.

While there are many games and toys that specifically target magic and wizardry as a central play theme, most offer only a superficially engaging play experience, particularly for older children. Very few offer a fully immersive play experience that allows participants to carry out and immerse themselves in a realistic fantasy experience of practicing, performing and mastering "real" magic. In any event, there is always demand for more exciting and entertaining games and toys that increase learning and entertainment opportunities for children and stimulate creativity and imagination.

SUMMARY

Embodiments of the present invention provide a unique play experience carried out utilizing an interactive "wand" and/or other seemingly magical actuation/tracking device. The wand or other actuation device allows play participants to electronically and "magically" interact with their surrounding play environment(s), thereby giving play participants the realistic illusion of practicing, performing and mastering "real" magic.

Embodiments of the invention may be carried out in association with virtually any suitable play environment, play structure, play area or other area (either commercial or residential), as desired. It can also be carried out in non-physical play environments, such as television, radio, virtual reality, computer games and the like. The play environment may be simply a themed play area, or even a multi-purpose area such as a restaurant dining facility, family room, bedroom or the like. The play environment may either be real or imaginary (i.e., computer/TV generated), and either local or remote, as desired. Optionally, multiple play participants, each provided with a suitable "wand" and/or other actuation/tracking device, may play and interact together, either within or outside one or more compatible play environments, to achieve desired goals, master certain magical spells and/or produce desired seemingly magical effects within the play environment.

In accordance with one embodiment the present invention provides a toy wand or other seemingly magical object which provides a basic foundation for a complex, interactive entertainment system to create a seemingly magic interactive play experience for play participants who possess and learn to use the magical wand toy.

In accordance with another embodiment, the present invention provides an interactive play system and seemingly magical wand toy for enabling a trained user to electronically send and receive information to and from other wand toys and/or to and from various transceivers distributed throughout a play facility and/or connected to a master control system. The toy wand or other seemingly magical object is configured to use a send/receive radio frequency communications protocol which provides a basic foundation for a complex, interactive entertainment system to create a seemingly magic interactive play experience for play participants who possess and learn to use the magical wand toy.

In accordance with another embodiment the present invention provides a "magic" training facility wherein play participants can select and/or build and then learn to use a "real" magic wand. The wand allows play participants to electronically and "magically" interact with their surrounding play environment simply by pointing, touching or using their wands in a particular manner to achieve desired goals or produce desired effects within the play environment. Various wireless receivers or actuators are distributed throughout the play facility to facilitate such interaction and to facilitate full immersion in the fantasy of practicing, performing and mastering "real" magic.

In accordance with another embodiment the present invention provides a wand actuator device for actuating various interactive play effects within a compatible play environment. The wand comprises an elongated hollow pipe or tube having a proximal end or handle portion and a distal end or transmitting portion. An internal cavity may be provided to receive one or more batteries to power optional lighting, laser or sound effects and/or to power long-range transmissions such as via an infrared LED transmitter device or RF transmitter device. The distal end of the wand may be fitted with an RFID (radio frequency identification device) transponder that is operable to provide relatively short-range RF communications (<60 cm) with one or more receivers or transceivers distributed throughout a play environment. A magnetic tip may also be provided for actuating various effects via one or

more magnetically operated reed switches. The handle portion of the wand may be fitted with an ornamental knob that is selected by play participants from an available assortment. Knobs may be fitted with an optional rotary switch that may be selectably rotated to indicate different spells, commands or combinations of spells and commands for activating or controlling various associated special effects.

In accordance with another embodiment the present invention provides a wand having an RFID transponder or tag. The transponder contains certain electronics comprising a radio frequency tag pre-programmed with a unique person identifier number ("UPIN"). The UPIN may be used to identify and track individual play participants and/or wands within the play facility. Optionally, each tag may also include a unique group identifier number ("UGIN"), which may be used to match a defined group of individuals having a predetermined relationship. The RFID transponder or other identifying device is preferably used to store certain information identifying each play participant and/or describing certain powers or abilities possessed by an imaginary role-play character. Players advance in a magic adventure game by finding clues, casting spells and solving various puzzles presented. Players may also gain (or lose) certain attributes, such as magic skills, magic strength, fighting ability, various spell-casting abilities, combinations of the same or the like. All of this information is preferably stored on the RFID transponder and/or an associated database indexed by UPIN so that the character attributes may be easily and conveniently transported to other similarly-equipped play facilities, computer games, video games, home game consoles, hand-held game units, and the like. In this manner, an imaginary role-play character is created and stored on a transponder device that is able to seamlessly transcend from one play environment to the next.

In accordance with another embodiment, the present invention provides an RFID card or badge intended to be affixed or adhered to the front of a shirt or blouse worn by a play participant while visiting an RF equipped play facility. The badge comprises a paper, cardboard or plastic substrate having a front side and a back side. The front side may be imprinted with graphics, photos, or any other information desired. The front side may include any number of other designs or information pertinent to its application. The obverse side of the badge contains certain electronics comprising a radio frequency tag pre-programmed with a unique person identifier number ("UPIN"). The UPIN may be used to identify and track individual play participants within the play facility. Optionally, each tag may also include a unique group identifier number ("UGIN") which may be used to match a defined group of individuals having a predetermined relationship.

In accordance with another embodiment, the present invention provides an electronic role-play game utilizing specially configured electronically readable character cards. Each card is configured with an RFID or a magnetic "swipe" strip or the like, that may be used to store certain information describing the powers or abilities of an imaginary role-play character that the card represents. As each play participant uses his or her favorite character card in various play facilities the character represented by the card gains (or loses) certain attributes, such as magic skill level, magic strength, flight ability, various spell-casting abilities, etc. All of this information is preferably stored on the card so that the character attributes may be easily and conveniently transported to other similarly-equipped play facilities, computer games, video games, home game consoles, hand-held game units, and the like. In this manner, an imaginary role-play character is created and stored on a card that is able to seamlessly transcend from one play medium to the next.

In accordance with another embodiment the present invention provides a trading card game wherein a plurality of cards depicting various real or imaginary persons, characters and/or objects are provided and wherein each card has recorded or stored thereon in an electronically readable format certain selected information pertaining to the particular person, character or object, such as performance statistics, traits/powers, or special abilities. The information is preferably stored on an RFID tracking tag associated with each card and which can be read electronically and wirelessly over a predetermined range preferably greater than about 1 cm when placed in the proximity of a suitably configured RF reader. Optionally, the RFID tag may be read/write capable such that it the information stored thereon may be changed or updated in any manner desired. Alternatively, a magnetic strip, bar code or similar information storage means may be used to store relevant information on the card.

For purposes of summarizing the invention and the advantages achieved over the prior art, certain objects and advantages of the invention have been described herein above. Of course, it is to be understood that not necessarily all such objects or advantages may be achieved in accordance with any particular embodiment of the invention. Thus, for example, those skilled in the art will recognize that the invention may be embodied or carried out in a manner that achieves or optimizes one advantage or group of advantages as taught herein without necessarily achieving other objects or advantages as may be taught or suggested herein.

All of these embodiments are intended to be within the scope of the invention herein disclosed. These and other embodiments of the present invention will become readily apparent to those skilled in the art from the following detailed description of the preferred embodiments having reference to the attached figures, the invention not being limited to any particular preferred embodiment(s) disclosed.

BRIEF DESCRIPTION OF THE DRAWINGS

Having thus summarized the general nature of the invention and its essential features and advantages, certain preferred embodiments and modifications thereof will become apparent to those skilled in the art from the detailed description herein having reference to the figures that follow, of which:

FIG. **1** is a schematic illustration of one embodiment of an interactive wand toy having features and advantages in accordance with the present invention;

FIGS. **2**A and **2**B are schematic illustrations of a mercury tilt switch for use in accordance with one embodiment of the present invention and being shown in the OFF and ON conditions, respectively;

FIGS. **3**A and **3**B are schematic illustrations of a micro-ball tilt switch (normally closed configuration) for use in accordance with one embodiment of the present invention and being shown in the ON and OFF conditions, respectively;

FIGS. **4**A and **4**B are schematic illustrations of a micro-ball tilt switch (normally open configuration) for use in accordance with one embodiment of the present invention and being shown in the ON and OFF conditions, respectively;

FIGS. **5**A and **5**B are schematic illustrations of the interactive wand toy of FIG. **1** in upward and downward orientations, respectively;

FIG. **6** is a partial perspective view of a user waving the interactive wand toy of FIG. **1** in such a way to produce actuation thereof;

FIG. **7** is a schematic illustration of an alternative embodiment of an interactive wand toy including an optional RF/IR module and having features and advantages in accordance with the present invention;

FIG. **8** is a schematic illustration of a further alternative embodiment of an interactive wand toy including an optional magnetic inductance energy source having features and advantages in accordance with the present invention;

FIG. **9** is a schematic illustration of a further alternative embodiment of an interactive wand toy including an optional piezo generator energy source having features and advantages in accordance with the present invention;

FIG. **10** is a schematic illustration of a piezo armature for use in a piezo generator having features and advantages in accordance with the present invention;

FIG. **11** is a schematic circuit diagram of the piezo generator and power supply of FIG. **9** having features and advantages in accordance with the present invention;

FIG. **12** is a schematic illustration of a further alternative embodiment of an interactive wand toy including an RF/IR module and optional RFID transponder having features and advantages in accordance with the present invention;

FIG. **13** is a schematic illustration of a further alternative embodiment of an interactive wand toy including an RF/IR module and optional RFID transponder having features and advantages in accordance with the present invention;

FIG. **14**A is a schematic illustration of a further alternative embodiment of an interactive wand toy including optional orientation sensors having features and advantages in accordance with the present invention;

FIG. **14**B is a detail transverse cross-sectional view of the handle portion of the interactive wand toy of FIG. **14**A, illustrating the preferred placement and orientation of the optional orientation sensors and having features and advantages in accordance with the present invention;

FIG. **15**A is a schematic illustration of a further alternative embodiment of an interactive wand toy including an optional rotary switch having features and advantages in accordance with the present invention;

FIG. **15**B is a detail transverse cross-sectional view of the handle portion of the interactive wand toy of FIG. **15**A illustrating one preferred embodiment of a rotary switch having features and advantages in accordance with the present invention;

FIG. **15**C is a partial perspective view of a user rotating the knob of the interactive wand toy of FIG. **15**A in such a way to produce a desired wand operation or effect;

FIG. **15**D is a detail view of the handle portion and rotatable knob of the interactive wand toy of FIGS. **15**A and **15**B;

FIG. **16**A is a schematic illustration of a further alternative embodiment of an interactive wand toy including optional touch sensor elements having features and advantages in accordance with the present invention;

FIG. **16**B is a detail view of one embodiment of a touch sensor element of FIG. **16**A having features and advantages in accordance with the present invention;

FIG. **16**C is a partial perspective view of a user operating the touch-sensor-enabled interactive wand toy of FIG. **15**A in such a way to produce a desired wand operation of effect;

FIG. **16**D is a detail view of the handle portion and touch sensor contact elements of the interactive wand toy of FIGS. **16**A and **16**C;

FIGS. **17A-17**B are time-sequenced illustrations of one embodiment of a wand-actuated effect using the interactive wand toy of FIG. **16** with optional magnetic tip and a magnetic reed switch having features and advantages in accordance with the present invention;

FIG. **17**C is an alternative embodiment of a wand-actuated effect using the interactive wand toy of FIG. **16** with optional magnetic tip, a magnetic reed switch and an optional RF/IR receiver having features and advantages in accordance with the present invention;

FIGS. **18**A and **18**B are schematic illustrations showing one preferred method for fabricating, assembling and finishing an interactive wand toy having features and advantages in accordance with the present invention;

FIGS. **19**A-**19**P are schematic illustrations showing various possible constructions, configurations and finishes of interactive wand toys having features and advantages in accordance with the present invention;

FIGS. **20**A and **20**B are schematic illustrations showing two alternative preferred embodiments of an RFID-enabled wand toy having features and advantages in accordance with the present invention;

FIGS. **20**C and **20**D are front and back views, respectively, of a preferred embodiment of an RFID-enabled trading card having features and advantages in accordance with the present invention;

FIGS. **20**E and **20**F are front and back views, respectively, of a preferred embodiment of an RFID-enabled key chain trinket having features and advantages in accordance with the present invention;

FIGS. **20**G and **20**H are front and rear views, respectively, of an optional RFID tracking badge or card having features and advantages in accordance with the present invention;

FIG. **21**A is a partial cross-section detail view of the distal end of the interactive wand toy of FIG. **1**, illustrating the provision of an RFID transponder device therein;

FIG. **21**B is a schematic illustration of an RFID read/write unit for use with the interactive wand toy of FIG. **1** having features and advantages in accordance with the present invention;

FIG. **21**C is a simplified circuit schematic of the RFID read/write unit of FIG. **21**B having features and advantages in accordance with the present invention;

FIG. **21**D is a simplified schematic diagram of an RF reader and master control system for use with the magic wand toy actuator of FIG. **20**A having features and advantages in accordance with the present invention;

FIGS. **21**E and **21**F are schematic diagrams illustrating typical operation of an RFID tracking tag as illustrated in FIG. **20**;

FIG. **21**G is simplified schematic diagram of an RFID read/write system for use with an RFID tracking tag as illustrated in FIG. **20** having features and advantages in accordance with the present invention;

FIG. **21**H is a simplified block diagram illustrating the basic organization and function of the electronic circuitry comprising an RFID tracking tag as illustrated in FIG. **20**;

FIG. **22**A is a simplified schematic block diagram of an RF transmitter module adapted for use in accordance with one preferred embodiment of the present invention;

FIG. **22**B is a simplified schematic block diagram of an IR transmitter module adapted for use in accordance with one preferred embodiment of the present invention;

FIG. **23**A is a simplified schematic block diagram of an RF receiver module and controller adapted for use in accordance with one preferred embodiment of the present invention;

FIG. **23**B is a simplified schematic block diagram of an IR receiver module and controller adapted for use in accordance with one preferred embodiment of the present invention;

FIG. **24** is a simplified schematic diagram of an alternative embodiment of a portion of the RF receiver module of FIG.

23A adapted for use in accordance with one preferred embodiment of the present invention;

FIG. **25** is a detailed electrical circuit schematic of the RF transmitter module of FIG. **22**A adapted for use in accordance with one preferred embodiment of the present invention;

FIG. **26** is a detailed electrical circuit schematic of the RF receiver module of FIG. **23**A adapted for use in accordance with one preferred embodiment of the present invention;

FIG. **27** is a simplified illustration of an interactive play system usable with light-activation in accordance with one preferred embodiment of the present invention;

FIG. **27**A is a simplified illustration of another embodiment of an interactive play system usable with light-activation;

FIG. **27**B is a simplified illustration of another embodiment of an interactive play system usable with light-activation;

FIG. **28** is a perspective illustration of one preferred embodiment of a wand-actuated play effect comprising a player piano controlled at least in part by the output of an RF receiver and/or magnetic reed switch having features and advantages in accordance with the present invention;

FIG. **29** is a perspective illustration of another preferred embodiment of a wand-actuated play effect comprising bookshelves with simulated levitating books controlled at least in part by the output of an RF receiver and/or magnetic reed switch having features and advantages in accordance with the present invention;

FIG. **30** is a perspective illustration of another preferred embodiment of a wand-actuated play effect comprising a water fountain effect controlled at least in part by the output of an RF receiver and/or magnetic reed switch having features and advantages in accordance with the present invention;

FIGS. **31**A and **31**B are time-sequenced perspective views of a magic training center comprising various wand-actuated play effects controlled at least in part by the output of one or more RF receivers and/or magnetic reed switches having features and advantages in accordance with the present invention;

FIG. **32**A is a perspective illustration of one preferred embodiment of a wand-actuated game comprising a grid of lighted squares that are controlled at least in part by one or more RF receivers and/or magnetic reed switches having features and advantages in accordance with the present invention;

FIGS. **32**B-**32**D are time-sequenced top plan views of the wand-actuated game of FIG. **32**A, illustrating the preferred operation thereof and having features and advantages in accordance with the present invention;

FIGS. **33**A-**33**D are front views of various role-play character cards for use within an interactive play structure;

FIGS. **34**A and **34**B are front and rear views, respectively, of an alternative embodiment of a role-play character card for use with a specially configured interactive game and/or game play facility having features and advantages in accordance with the present invention;

FIGS. **35**A-**35**G are various illustrations of a role-play adventure game configured to be utilized with the role-play character card of FIGS. **34**A and **34**B and having features and advantages in accordance with the present invention;

FIGS. **36**A and **36**B are front and rear views, respectively, of a trading or playing card having features and advantages in accordance with the present invention; and

FIGS. **36**C and **36**D are front views of several alternative embodiments of trading or playing cards having features and advantages in accordance with the present invention.

DETAILED DESCRIPTION

For convenience of description and for better clarity and understanding of the invention similar elements to those previously described may be identified with similar or identical reference numerals. However, not all such elements in all embodiments are necessarily identical as there may be differences that become clear when read and understood in the context of each particular disclosed preferred embodiment.

Interactive Wand

A wand is provided that allows play participants to electronically and "magically" interact with their surrounding play environment simply by pointing or using their wands in a particular manner to achieve desired goals or produce desired effects within the play environment. Use of the wand may be as simple as touching it to a particular surface or "magical" item within a suitably configured play environment or it may be as complex as shaking or twisting the wand a predetermined number of times in a particular manner and/or pointing it accurately at a certain target desired to be "magically" transformed or otherwise affected.

For example, various wand-compatible receivers may be distributed throughout a play facility that will allow wand users to activate various associated play effects and/or to play a game using the wand. As play participants play and interact within each play environment they learn more about the "magical" powers possessed by the wand and become more adept at using the wand within various game contexts to achieve desired goals or desired play effects. Optionally, play participants may collect points or earn additional magic levels or ranks for each play effect or task they successfully achieve. In this manner, play participants may compete with one another to see who can score more points and/or achieve the highest magic level.

Additional optional circuitry and/or position sensors may be added, if desired, to allow the "magic wand" **100** to be operated by waving, shaking, stroking and/or tapping it in a particular manner. If provided, these operational aspects would need to be learned by play participants as they train in the various play environments. One goal, for example, may be to become a "grand wizard" or master of the wand. This means that the play participant has learned and mastered every aspect of operating the wand to produce desired effects within each play environment. Of course, additional effects and operational nuances can (and preferably are) always added over time in order to keep the interactive experience fresh and continually changing. Optionally, as shown and discussed in more detail in connection with FIG. **19**G, the wand may be configured such that it is able to display 50 or more characters on a LTD or LCD screen. The wand may also be configured to respond to other signals, such as light, sound, or voice commands as will be readily apparent to those skilled in the art.

FIG. **1** illustrates the basic construction of one preferred embodiment of an interactive "magic" wand toy **100** having features and advantages in accordance with the present invention. While a magic wand is specifically contemplated and described herein as the most preferred embodiment of the invention, those skilled in the art will readily appreciate from the disclosure herein that the invention is not limited to wands, but may be carried out using any number or variety of other objects and toys for which it may be desirable to imbue special "magic" powers or other functionalities described herein. Other suitable magical objects and toys may include, for example and without limitation, ordinary sticks, tree branches, flowers, swords, staffs, scepters, whips, paddles, nunchuks, cricket bats, baseball bats, various sporting balls, brooms, feather dusters, paint brushes, wooden spoons, chop sticks, pens, pencils, crayons, umbrellas, walking canes, candy canes, candle sticks, candles, tapers, musical instruments (e.g., flutes, recorders, drum sticks), books, diaries, flashlights, telescopes, kaleidoscopes, laser pointers, ropes, tassels, gloves, coats, hats, shoes and other clothing items, fishing rods and simulated fishing rods, dolls, action figures, stuffed animals, rings, bracelets necklaces and other jewelry items, key chain trinkets, lighters, rocks, crystals, crystal balls, prisms, and various simulated play objects such as apples, arranges, bananas, carrots, celery and other fruits/vegetables. However, magic wands are particularly preferred because they are highly versatile, can transcend a wide variety of different play themes and play environments, and wands can be customized and personalized in their fabrication, assembly and finish as will be described herein in more detail.

As illustrated in FIG. **1**, the wand **100** essentially comprises an elongated hollow pipe or tube **110** having a proximal end **112** and a distal end **114**. An internal cavity **116** is preferably provided to receive and safely house various circuitry for activating and operating the wand and various wand-controlled effects (described later). Batteries, optional lighting, laser or sound effects and/or the like may also be provided and housed within cavity **116**, if desired, as will be described in more detail later. An optional button may also be provided, if desired, to enable particular desired functions, such as sound or lighting effects or longer-range transmissions. While a hollow metal or plastic tube **110** is preferred, it will be appreciated that virtually any other mechanical structure or housing may be used to support and contain the various components and parts described herein, including integrally molded or encapsulated containment structures such as epoxy resins and the like. If a metal tube is selected, care must be taken to ensure that it does not unduly interfere with any of the magnetic, RFID or RF/IR devices described herein. Thus, for example, any RF antennas should preferably be mounted near or adjacent an end opening and/or other opening of the tube **110** to ensure adequate operating range and desired directionality.

The proximal end **112** of tube **110** is preferably adapted to secure the tube **110** to an optional handle **120**. The handle **120** may further include securement means, such as threaded stud **121**, snap latches, mating magnets or the like, for receiving and securing an optional decorative knob **123**. For example, knobs **123** may be purchased, selected and/or earned by play participants as they advance in a game and/or when they play different games. The distal end **114** of the wand is preferably fitted with an RFID (radio frequency identification) transponder or tag **118** that is operable to provide relatively short-range RF communications (less than about 200 cm) using one or more RFID reader units or reader/writer units (sometimes referred to herein as "receivers" or "transceivers," respectively), described in more detail later. The transponder **118** contains certain electronics comprising a radio frequency tag pre-programmed with a unique person identifier number ("UPIN"). The UPIN may be used to identify and track individual wands and/or play participants. Optionally, each tag may also include a unique group identifier number ("UGIN") which may be used to match a defined group of individuals having a predetermined or desired relationship.

The RFID transponder is preferably used to store certain information identifying each play participant and/or describing certain powers or abilities possessed by an imaginary role-play character. For example, players may advance in a magic adventure game by finding clues, casting spells and solving various puzzles presented. Players may also gain (or lose) certain attributes, such as magic skills, magic strength, fighting ability, various spell-casting abilities, combinations of the same or the like, based on game play, skill-level and/or the purchase of collateral play objects. Some or all of this information is preferably stored on the RFID transponder **118** so that the character attributes may be easily and conveniently transported to various compatible play facilities, games, video games, home game consoles, hand-held game units, and the like. Alternatively, only the UPIN and/or UGIN are stored on the transponder **118** and all other desired information is stored on a computer-accessible database indexed by UPIN and/or UGIN.

Operation of the transponder **118** (and/or other wireless communication devices described later) is preferably controlled by internal activation circuitry **115** comprising, in the particular embodiment illustrated, a pair of series-connected mercury tilt sensors **122** and **124** (represented in the corresponding schematic diagram as switches S**1** and S**2**, respectively). As illustrated in FIGS. **2**A and **2**B each mercury tilt sensor **122**, **124** comprises a sealed, evacuated glass bulb **130** within which is contained a small ball of liquid mercury. A pair of electrical leads **134** extends through the glass bulb **130** at the sealed end thereof and form closely spaced contacts **136**. In one orientation (e.g., FIG. **2**B) the ball of mercury **132** is drawn by gravity to cover or envelope the contacts **136**, thus completing the electrical circuit and closing the switch S**1**/S**2** (ON state). In all other orientations (e.g., FIG. **2**A) the ball of mercury **132** does not contact or envelope both contacts **136** and, thus, the circuit remains open (OFF state). The particular orientation and tilt angle required to trigger either ON or OFF conditions will depend on the size of the glass bulb **130**, amount of contained mercury **132** and the size and spacing of contacts **136**. If mercury sensors are used, preferably they are encased in a metal and/or epoxy jacket so as to ensure against breakage and possible health and environmental hazards. Preferably, each mercury sensor is encased in epoxy within a sealed stainless steel ferule.

Alternatively, one or more micro-ball tilt sensors **136** or **138** may be used instead of or in addition to mercury switches **122**, **124**. For example, FIGS. **3**A and **3**B are schematic illustrations of a micro-ball tilt switch **136** (normally closed configuration) that may be adapted for use in accordance with an alternative embodiment of the invention. The tilt switches **136**, **138** generally comprise upper and lower conductive enclosures **142**, **146**, respectively, separated by a suitable insulating material **144** and a conductive ball **140** that is free to move within. In one orientation (e.g., FIG. **3**A) the internally contained conductive ball **140** rests within an annular groove completing the electrical circuit between the top conductive enclosure **142** and bottom conductive enclosure **146** (ON state). But, when the sensor **136** is tilted by an amount greater than angle α (FIG. **3**B), the ball **140** rolls away from the lower conductive enclosure **141** and, thus, the circuit is opened (OFF state).

FIGS. **4**A and **4**B are schematic illustrations of another embodiment of a micro-ball tilt switch **138** (normally open configuration) that may also be adapted for use in accordance with a further alternative embodiment of the present invention. In this case, in a first orientation (e.g., FIG. **4**A) an internally contained conductive ball **140** rests within a central conical pocket formed in the lower conductive enclosure **146** and is thereby prevented from contacting and completing electrical connection to the upper conductive enclosure **142** (OFF state). But, when the sensor **138** is tilted by an amount greater than angle α (FIG. **4**B) the ball **140** rolls out of the conical pocket, touching and completing the circuit with the upper conductive enclosure **142** (ON state). The particular orientation and range of tilt angles required to trigger either ON or OFF conditions of micro-ball sensors **136**, **138** can be varied and/or adjusted to meet varying needs and skill levels of wand users.

Referring to FIGS. **5**A and **5**B tilt sensors **122** and **124** are preferably oppositely oriented and spaced apart between opposite ends of the tube **110**, as illustrated. Those skilled in the art will appreciate from the disclosure herein that in virtually any static position of the wand **100** at least one of tilt sensors **122**, **124** will be in the OFF state. Thus, the transponder **118** can essentially only be activated when the wand is in a non-static condition or, in other words, when the wand is in motion. More specifically, the placement and orientation of the tilt sensors **122**, **124** is preferably such that different accelerations or motions are required at the proximal and distal ends **112** and **114** in order to trigger both tilt sensors **122**, **124** to their ON positions (or OFF positions, as the case may be) and, thus, to enable or activate transponder **118** (or other wireless communication devices described later).

As illustrated in FIG. **5**A, when the wand **100** is held in an upright orientation, tilt sensor **122** (S**1**) is in its ON state (Static-ON) and tilt sensor **124** (S**2**) is in its OFF state (Static-OFF). Because the sensors are wired in series, the activation circuit **115** is OFF (open circuit) and the transponder **118** is disabled. Of course, those skilled in the art will readily appreciate from the disclosure herein that if transponder **118** requires a short circuit to disable, then the sensors **122** and **124** would preferably be wired in parallel and, in the orientation shown, the activation circuit **115** would be shorted through S**1**. On the other hand, when the wand **100** is held in an upside down orientation (FIG. **5**B), tilt sensor **122** (S**1**) is in its OFF state (Static-OFF) and tilt sensor **124** (S**2**) is in its ON state (Static-ON) such that the activation circuit **115** remains OFF (open circuit) and the transponder **118** remains disabled. Again, if transponder **118** requires a short circuit to disable, then the sensors **122** and **124** would preferably be wired in parallel and, in the orientation shown, the activation circuit **115** would be shorted through S**2**.

Advantageously, the wand activation circuit **115** in accordance with the above-described preferred embodiment is essentially only activated (and transponder **118** is only enabled) when a user actively moves the wand **100** in such particular way as to impart different transient acceleration forces on the distal and proximal ends of the wand **100** (or wherever the sensors are located if not at the distal and proximal ends). In particular, the transient acceleration forces must be sufficient enough at one end of the wand to overcome the gravitational forces acting on the upper sensor (Static-OFF), but not sufficient enough at the other end to overcome the gravitational forces acting on the lower sensor (Static-ON). This transient condition is illustrated in FIG. **6**.

The wand activation circuit **115** (and, thus, transponder **118**) is activated by holding the wand tilted slightly upward in one hand while gently and smoothly waving it so that the distal end **114** of the wand follows an upward-cresting arcing pattern while the proximal end **112** remains relatively steady or follows a smaller, more gentle arcing pattern. The acceleration forces caused by the upward arcing motion at the distal end **114** counteract gravitational forces on the tilt sensor **124** and cause it to switch from its OFF state to its ON state. At the same time, the smaller arcing motion and acceleration forces at the proximal end **112** are not sufficient to counteract the gravitation forces on the tilt sensor **122** and, thus, it remains in its ON state. The result is that both sensors **122** and **124** are momentarily in their ON state and the wand activation circuit **115** thereby momentarily activates the transponder **118**. The complexity and learnability of the described motion is similar to a golf swing. Only with this particular motion (or other similar learned motions) executed in a precise and repeatable fashion will the transient conditions be satisfied to cause both sensors **122** and **124** to switch to their ON state, thereby momentarily activating transponder **118**. If the arcing motion is too fast or too pronounced, the lower sensor **122** will switch to its OFF state. On the other hand, if the arcing motion is too slow or too shallow, the upper sensor **124** will not switch to its ON state. Thus, successful operation of the wand **100** requires real skill, patience and training.

Those skilled in the art will readily appreciate and understand from the disclosure herein that various additional and/or alternative wand activation circuits can be designed and configured so as to respond to different desired wand activation motions. For example, this may be achieved by adding more sensors and/or by changing sensor positions and orientations. For example, one wand motion may trigger a first wand activation circuit (and a first wand effect) while a different wand motion may trigger a second wand activation circuit (and a second wand effect). The number, type and complexity of wand motions and corresponding wand activation circuits are limited only by design and cost considerations and user preferences. Most desirably 6-12 unique wand activation motions and corresponding wand activation circuits are provided. Of course, those skilled in the art will recognize from the disclosure herein that multiple wand activation circuits may share one or more sensors and/or other supporting circuitry and components, as required or desired. Alternatively, a single, multi-mode wand activation circuit may be provided that can respond to multiple wand motions.

The degree of difficulty and skill required to master each wand motion can preferably be adjusted to suit the age and skill-level of each user. Generally speaking, selecting tilt sensors **122**, **124** having narrow activation ranges increases the difficulty level of the wand, as it makes it more difficult to satisfy the transient conditions required to turn each sensor to its ON or active state. Similarly, adding more sensors also increases the difficulty level, as it decreases the probability that all required transient conditions can be satisfied in a given moment. Placement and orientation of the sensors **122** and **124** (and any other sensors) can also make a difference in the degree of difficulty and skill required. For example, spacing the sensors closer together (e.g., 3-5 cm apart) generally makes it more difficult to operate the wand as it becomes harder and harder to create different transient conditions relative to each sensor location. Conversely, spacing sensors farther apart (e.g., 10-35 cm apart) makes it easier. An optimal sensor spacing is about 8-12 cm. Optionally, some or all of these degree-of-difficulty parameters can be adjusted or changed as skill-levels increase or as other circumstances warrant.

Of course, those skilled in the art will appreciate from the disclosure herein that the wand activation circuitry **115** is not limited to those including mercury or micro-ball tilt sensors, as illustrated, but may be practiced using a wide variety of other motion and/or tilt sensors and/or other supporting circuitry elements and components that are selected and adapted to the purposes described herein. These include, without limitation, impact sensors, micro-sensors, gyro-sensors, force sensors, micro-switches, momentum sensors, vibration sensors, gravity sensors, accelerometers, and all variety of reed switches (gravity, momentum, magnetic or otherwise). Moreover, any one or more of these and/or other similar sensor devices may also be used in conjunction with other supporting circuitry elements or components (either internal or external to the wand **100**) as desired, including microprocessors, computers, controller boards, PID circuitry, input/output devices, combinations of the same and the like. Mercury and micro-ball tilt sensors as illustrated and described above are particularly preferred as they are relatively inexpensive and reliable.

FIG. **7** is a schematic illustration of an alternative embodiment of an interactive wand **100***a* including an optional RF/IR module adapted for long-range wireless communications (up to about 100 meters). Wand **100***a* is essentially the same as wand **100** illustrated and described above in connection with FIG. **1**, except longer-range wand operation is achieved by replacing the RFID transponder **118** in wand **100** (FIG. **1**) with an auxiliary RF/IR transmitter **150** (see FIGS. **22** and **25** accompanying discussion for circuit schematic and other details). If line of sight or directional actuation is desired, an infrared LED transmitter of the type employed in standard television remote controls may be provided instead of or in addition to the RF transmitter **118**, as those skilled in the art will readily appreciate. In the latter case, a hole (not shown) would preferably be provided in the distal end **114** of the wand to accommodate the transmitting LED of the IR transmitter circuit. Of course, a wide variety of other wireless communications devices, as well as various optional sound and lighting effects may also be provided, as desired.

RF/IR transmitter module **150** and/or any other desired optional effects may be actuated using the wand activating circuit **115** substantially as illustrated and described above in connection with FIGS. **1**-**6**. As illustrated in FIG. **7**, tilt sensors **122**, **124** (S1/S2) are wired in series with the RF/IR module, between batteries **152** (voltage source V+) and ground (all or part of tube **110**). Thus, RF/IR module **150** is powered when sensors **122** and **124** are both in their ON state (switches S1 and S2 are both closed). Again, this transient state can essentially only be achieved when a skilled user actively moves the wand **100***a* in such particular way as to impart different transient acceleration forces on the distal and proximal ends of the wand **100***a*, as illustrated and described above in connection with FIG. **6**. Other than as noted above it will be understood that the wand **100***a* is in all other material respects essentially the same as wand **100** illustrated and described in connection with FIGS. **1**-**5**. Note that the handle **120***a* and knob **123***a* are slightly modified, as these elements are preferably uniquely customized/personalized for each wand and/or wand user as will be discussed in more detail later.

Furthermore, the wand activation circuitry **115** may advantageously comprise a microprocessor that communicates with the sensors **122**, **124** and the transmitter module **150**. In one embodiment, the microprocessor receives at least one signal from the sensors **122**, **124** indicative of the state of the sensors. For instance, the microprocessor may determine when each of the sensors **122**, **124** are in an ON or an OFF state or when one of the sensors **122**, **124** switches states. Based on the states of the sensors **122**, **124**, the microprocessor then outputs a signal to the transmitter module **150** that causes activation or deactivation of the transmitter module **150**.

In another embodiment, the microprocessor is capable of measuring a duration of time related to the operational states of the sensors **122**, **124**. For example, the microprocessor may use a clock signal or an external timer to determine the duration of time during which at least one of the sensors **122**, **124** is in an ON state. The microprocessor may then use this duration of time when outputting a signal to the transmitter module **150**. For example, the microprocessor may correlate the duration of time that a sensor **122**, **124** is activated (e.g., in an ON state) with an intensity, level, or type of a "spell" being cast by the user. For instance, if the user, while "casting a spell," is able to move the wand **100** so as to keep at least one of the sensors **122**, **124** activated for a certain period of time, the microprocessor may assign a particular level or intensity to the spell being cast. Thus, the microprocessor may output different signals, which represent different spells or spell intensities, to the transmitter module **150** based on the length of time of the sensor activation. In one embodiment, the microprocessor may associate longer durations of sensor activation with higher intensity spells.

In yet other embodiments, the microprocessor calculates the duration of time between successive activations, or triggering, of the sensors **122**, **124**. For example, the microprocessor may determine how much time passes between the activation of the sensor **122** and the activation of the sensor **124**, which are caused by the user's operation of the wand **100**. For instance, the microprocessor may associate simultaneous or shorter durations of time between the activations of the two sensors **122**, **124** with a more advanced, or higher-level, spell. Thus, the user that operates the wand **100** so as to activate each of the sensors **122**, **124** within a relatively short period of time is able to cast higher-level spells. On the other hand, if there is a greater delay between the activations of the sensors **122**, **124**, the microprocessor assigns a lower intensity level to the spell being cast. In yet other embodiments, the time during or between the sensor activations is used by the microprocessor to determine which of a variety of spells is achieved by the user.

In other embodiments, the microprocessor may compare the duration of time of sensor activation or time between successive activations, to a predetermined time. For example, if the duration of time between successive activations is less than the predetermined time, the "spell" may be assigned a higher intensity level. If the duration of time between successive activations is greater than the predetermined time, the "spell" may be assigned a higher lower level. In addition, in some embodiments, the microprocessor does not calculate the specific value of the duration of time but determines if the duration of time exceeds or does not exceed a predetermined time.

In yet other embodiments of the invention, the duration of time during or between activation of the sensors **122**, **124** is output to a receiver external to the wand **100**. The receiver then processes the duration of time in determining which effect, or which level of an effect, is caused by the particular wand activation motions and associated duration(s) of time. In yet other embodiments, the foregoing microprocessor may be used in a wand **100** comprising a transponder **118** instead of, or in combination with, the transmitter module **150**.

In another embodiment, the microprocessor accesses a look-up table that associates specific durations of time, or ranges of durations of time, with the intensity or the type of the spell being cast. For example, the look-up table may associate durations of time less than 0.1 seconds between successive sensor activations with a higher level spell, durations of time from 0.1 to 0.2 seconds with a mid-level spell, and durations of time greater than 0.2 seconds with a lower level spell. In one embodiment, the look-up table is stored in a memory, such as for example a read-only memory (ROM), on the wand **100**. The look-up table may be internal or external to the microprocessor. In yet other embodiments, the look-up table may be accessible by the receiver of the signal from the wand **100**.

FIG. **8** is a schematic illustration of a further alternative embodiment of an interactive wand toy including an optional magnetic inductance energy source. Wand **100***b* is essentially the same as wand **100** illustrated and described above in connection with FIG. **1**, except that batteries **152** are replaced with a magnetic inductance energy generator **162**. The magnetic inductance energy generator **162** comprises an inductance coil L**1** sized and arranged such that when it is exposed to a fluctuating magnetic field (e.g., a moving permanent magnet **164** rubbed back and forth and/or an externally generated electromagnetic field) an alternating current is generated. This generated current is rectified by diode D**1** or, alternatively, a full wave bridge rectifier (not shown), and charges preferably an electrolytic capacitor C**1** until it reaches a predetermined operating voltage V+. If desired, a voltage regulator device, such as a zener diode (not shown) and/or active regulation circuitry may be added to stabilize and increase the efficiency of the magnetic inductance energy generator **162**.

Alternatively, those skilled in the art will appreciate from the disclosure herein that a various magnetic field effect sensors, such as Wiegand sensors and the like, may readily be used in place of or in addition to inductor L**1** where, for example, it is desired to increase the energy-generating efficiency of the circuit **162**. For example, U.S. Pat. No. 6,191,687 to Dlugos discloses a Wiegand effect energy generator comprising a Wiegand wire that changes its magnetic state in response to being exposed to an alternating magnetic field. The Wiegand wire has core and shell portions with divergent magnetic properties. The magnetic properties of the wire are such that it produces an output power signal that corresponds to the strength and rate of change of a magnetic field to which the Wiegand wire is exposed. Such energy pulses generally are between about 5 and 6 volts and 10 microseconds in width. Such energy pulses have sufficient voltage and duration to power a low power transmitter such as RF/IR module **150**. One suitable Wiegand sensor that may be utilized in accordance with the present invention is the series **2000** sensor sold by EHD Corp. The Series 2000 Wiegand sensor produces pulses in response to alternating magnetic fields or permanent magnets that pass near the sensor.

The energy generating circuit **162** is preferably such that the wand **100***b* has no movable parts and requires no maintenance such as replacing batteries or the like over its anticipated life. All energy is generated and stored by rubbing the wand back and forth with a permanent magnet and/or by placing the wand within an externally generated electromagnetic field. Preferably, the inductor L**1** (or Wiegand wire) and capacitor C**1** are selected such that 5-10 seconds of exposure to an external fluctuating magnetic field will fully charge the capacitor C**1**, thus enabling the wand RF/IR transmitter to be activated at least once and preferably 5-20 times without having to recharge. Advantageously, the absence of replaceable batteries or other visible electronic technology significantly increases the reality and full immersion experience of the magical fantasy and gives users the feeling of practicing, performing and mastering "real" magic using a "real" magic wand **100***b*. Optionally, a non-replaceable permanent rechargeable battery and/or a factory replaceable battery (not shown) may be provided in place of or in addition to the energy generating circuit **162** where it is desired to provide long-term energy storage. Other than replacing batteries **152** with magnetic inductance energy generator **162**, the wand **100***b* is in all other material respects essentially the same as wand **100***a* illustrated and described above in connection with FIG. **7**. Note that the handle **120***b* and knob **123***b* are slightly modified, as these elements are preferably uniquely customized/personalized for each wand and/or wand user as will be discussed in more detail later.

FIG. **9** is a schematic illustration of a further alternative embodiment of an interactive wand toy including an optional piezoelectric generator. Wand **100***c* is essentially the same as wand **100***b* illustrated and described above in connection with FIG. **8**, except that magnetic inductance energy generator **162** has been replaced with a piezo generator **166** and power supply **168**.

Piezoelectricity refers to a unique property of certain materials such as quartz, Rochelle salt, and certain solid-solution ceramic materials such as lead zirconate-titanate (Pb(ZrxTi1-x)O3) ("PZT") that causes induced stresses to produce an electric voltage or, conversely, that causes applied voltages to produce an induced stress. In a "generator" mode, electricity is developed when a piezoelectric ("piezo") crystal is mechanically stressed. Conversely, in a "motor" mode, the piezo crystal reacts mechanically when an electric field is applied.

PZT is one of the leading piezoelectric materials used today. It can be fabricated in bimorph or unimorph structures (piezo elements), and operated in flexure mode. These structures have the ability to generate high electrical output from a source of low mechanical impedance (conversely, to develop large displacement at low levels of electrical excitation). Typical applications include force transducers, spark pumps for cigarette lighters and boiler ignition, microphone heads, stereophonic pick-ups, etc.

It is known that piezo elements can be used to generate small a mounts of useful energy from motion. For example, U.S. Pat. No. 3,456,134 to Ko, incorporated in its entirety by reference herein, discloses a piezoelectric energy converter for electronic implants, wherein body motion is converted into electrical energy using a piece of piezoelectric PZT in the form of a resonant cantilever beam. See also, U.S. Pat. No. 6,438,193 to Ko et. al, which discloses a similar piezo generator for self-powered tire revolution counter. Such piezo generators have particular application and benefit to batteryless toys and wands of the type disclosed and described herein.

FIG. **10** is a cross-sectional view of such a piezo generator **166** comprising a "bimorph" piezo element **170** rigidly mounted at one end forming a cantilever beam. A "bimorph" is a flexing-type piezoelectric element, which has the capacity for handling larger motions and smaller forces than single piezoelectric plates. The bimorph piezo element **170** comprises two planar piezo crystals secured together face-to-face with a shim or vane therebetween. Mechanical bending of the element **170** causes it to produce a corresponding voltage between output electrodes **176**, **178**.

The piezoelectric element **170** is mounted and enclosed within the distal end of tube **110** (FIG. **9**) and its free end is loaded with a small weight **174** selected to resonate at a suitable frequency corresponding to the likely or anticipated movement of the wand **100***c*. A typical measured oscillation frequency is on the order of 10-100 Hz. As the wand is moved periodically, the piezo element **170** vibrates back and forth producing electrical pulses. These electrical pulses are then rectified by a full wave bridge rectifier **180** (FIG. **11**), are filtered by a filter circuit comprising capacitors C**1**, C**2** and resisters R**0**, R**1** and are stored in an energy storage capacitor C**3**, preferably a low-voltage electrolytic capacitor.

In order to draw maximum power from the piezo element **170**, the power supply circuit **168** "load" impedance preferably is selected to match the output impedance of the piezo element **170**. In order to minimize the ripple effect (peak-to-peak magnitude of rippling imposed on the nominal DC voltage level) energy storage capacitor C3 is preferably selected to be as large as possible, given available space constraints. To improve the stability of the power-supply an optional voltage regulator **182** may be added. For example, an LM185 IC band-gap voltage regulator may be chosen.

The piezo generator and power supply circuits **166**, **168** preferably have sufficient power output under normal operating conditions such that the wand **100***c* requires no other internal energy sources such as replaceable batteries or the like. All energy is generated and stored by normal motion of the wand during use, e.g. during spell casting or during normal walking or running while carrying the wand **100***c*. Preferably, the energy storage capacitor C**3** is selected such that when fully charged, it provides sufficient stored energy to enable the wand to be activated at least once and preferably 50-100 times without having to recharge. Advantageously, the absence of replaceable batteries or other visible electronic technology significantly increases the reality and full immersion experience of the fantasy and gives users the feeling of practicing, performing and mastering "real" magic using a "real" magic wand **100***c*. Optionally, a non-replaceable permanent rechargeable battery and/or a factory replaceable battery (not shown) may be provided in place of or in addition to the energy generating circuit **166** where it is desired to provide long-term energy storage. The wand **100***c* in all other material respects is essentially the same as wand **100***b* illustrated and described above in connection with FIG. **8**. Note that the handle **120***c* and knob **123***c* are slightly modified, as these elements are preferably uniquely customized/personalized for each wand and/or wand user as will be discussed in more detail later.

FIG. **12** is a schematic illustration of a further alternative embodiment of an interactive wand toy including an RF/IR module and optional RFID transponder. Wand **100***d* is essentially the same as wand **100***b* illustrated and described above in connection with FIG. **8**, except for the addition of optional RFID transponder **118***d*.

As with the RFID transponder **118** illustrated and described above in connection with FIG. **1**, RFID transponder **118***d* is operable to provide relatively short-range RF communications (less than about 200 cm) using one or more RFID reader units or reader/writer units, described in more detail later. The transponder **118***d* also preferably contains certain electronics comprising a radio frequency tag pre-programmed with a unique person identifier number ("UPIN"). The UPIN may be used to identify and track individual wands and/or play participants. Optionally, each tag **118***d* may also include a unique group identifier number ("UGIN") which may be used to match a defined group of individuals having a predetermined or desired relationship.

The RFID transponder is preferably used to store certain information identifying each play participant and/or describing certain powers or abilities possessed by an imaginary role-play character. For example, players may advance in a magic adventure game by finding clues, casting spells and solving various puzzles presented. Players may also gain (or lose) certain attributes, such as magic skills, magic strength, fighting ability, various spell-casting abilities, combinations of the same or the like, based on game play, skill-level and/or the purchase of collateral play objects. Some or all of this information is preferably stored on the RFID transponder **118***d* so that the character attributes may be easily and conveniently transported to various compatible play facilities, games, video games, home game consoles, hand-held game units, and the like. Alternatively, only the UPIN and UGIN are stored on the transponder **118** and all other desired information is stored on a computer-accessible database indexed by UPIN and/or UGIN.

If desired, RFID transponder **118***d* may be electronically interlocked and controlled by a corresponding wand activation circuit such as illustrated and described above in connection with FIG. **1**. More preferably, however, the RFID tag **118***d* is not interlocked, but is always activated. In this manner, transponder **118***d* can be easily read at short range using an RFID reader/writer (described later) to sense and track play participants and/or to activate various simple wand effects. Longer range RF communications via RF/IR module **150** are preferably only enabled when an appropriate wand activation motion is executed as described above in connection with FIGS. **1-6**. The wand **100***d* in all other material respects is essentially the same as wand **100***b* illustrated and described above in connection with FIG. **8**. Note that the handle **120***d* and knob **123***d* are slightly modified, as these elements are preferably uniquely customized/personalized for each wand and/or wand user as will be discussed in more detail later.

FIG. **13** is a schematic illustration of a further alternative embodiment of an interactive wand toy including an RF/IR module and optional RFID transponder. Wand **100***e* is essentially the same as wand **100***d* illustrated and described above in connection with FIG. **12**, except for the location and placement of the RFID transponder **118***e*.

As with the RFID transponder **118***d* illustrated and described above in connection with FIG. **12**, RFID transponder **118***e* provides relatively short-range RF communications using one or more RFID reader units or reader/writer units, described in more detail later. The transponder **118***e* also preferably contains certain electronics comprising a radio frequency tag pre-programmed with a unique person identifier number ("UPIN") and unique group identifier number ("UGIN"). Preferably, RFID tag **118***e* is always activated so that it can be easily read at short range using an RFID reader/writer (described later) to sense and track play participants and/or to activate various simple wand effects. Placing the RFID tag **118***e* in the handle **120***e*, allows for modular construction and functionality of a wand **100***e* as auxiliary handles may be interchanged having other unique RFID tags with unique stored information. Optionally, the tag-containing handle **120***e* and knob **123***e* may be omitted altogether in the case, for example, where a less expensive wand is desired.

As described above, longer range RF communications via RF/IR module **150** are preferably enabled only when an appropriate wand activation motion is executed as described above in connection with FIGS. **1-6**. The wand **100***e* in all other material respects is essentially the same as wand **100***d* illustrated and described above in connection with FIG. **12**. Note that the handle **120***e* and knob **123***d* are slightly modified, as these elements are preferably uniquely customized/personalized for each wand and/or wand user as will be discussed in more detail later.

In certain advanced applications, it is desirable to wirelessly communicate specific data and commands to achieve different or varied wand effects. For example, it may desirable to wirelessly send one command signal that turns a certain object (e.g., a lamp) "OFF" and another command signal that turns an object "ON". As described above in connection with FIGS. **1-6**, this functionality may be achieved using multiple wand activation circuits (or a single multi-mode circuit) responsive to various unique wand motions whereby each wand motion, if executed successfully, causes a different RF or IR signal to be transmitted to control or activate the desired effect (e.g., turning a light ON or OFF or simulating the levitation of an object).

Another convenient way to achieve similar functionality is to load data bits representing specific desired commands directly into a data buffer of RF/IR module **150***f* (FIG. **14**A) and then, using only a single wand activation circuit and a single learned wand motion, cause an RF or IR signal to be transmitted, thereby carrying the command signal and data to an RF or IR receiver and associated effect. Thus, for example, one or more tilt sensors **192**, **194** (illustrated schematically as switches S3/S4) may be provided in a convenient location within the wand **100***f* (e.g., within the handle **120**). These sensors are preferably mounted and oriented such that axial rotation of the wand shaft **110** and/or wand handle **120***f* causes the sensors to alternately switch from their ON to their OFF state. As illustrated in the circuit schematic accompanying FIG. **14**A, each sensor controls one data input bit of the RF/IR module data bus (e.g., S**3**, S**4**).

Preferably, sensors **192**, **194** are disposed at an angle of between about 60 and 120 degrees (most preferably about 90 degrees) from one another within a transverse plane of the wand (see, e.g., FIG. **14**B). Those skilled in the art will readily appreciate that in this manner, four possible wand orientations are possible resulting in four unique sensor pair states as follows: ON/ON; OFF/OFF; ON/OFF and OFF/ON. These four sensor states can represent, for example, four unique command signals sent using the RF/IR module **150***f*. The wand **100***f* in all other material respects is essentially the same as wand **100***b* illustrated and described above in connection with FIG. **8**. Note that the handle **120***f* and knob **123***f* are slightly modified, as these elements are preferably uniquely customized/personalized for each wand and/or wand user as will be discussed in more detail later.

Where it is desired to send a larger number of unique command signals, various combinations of additional orientation sensors and/or wand activation circuits may be added, as desired. Alternatively, various dials, switches and/or other inputs may be provided for selecting from a number of unique wand commands or "spells." For example, in one preferred embodiment illustrated in FIGS. **15**A-C a wand **100***g* is provided including a knob-actuated rotary switch **202** which directly loads up to 4 data bits (up to 16 possible unique codes) representing specific desired commands directly into a data buffer of RF/IR module **150***g* (FIG. **15**A).

As illustrated in FIG. **15**C a user rotates the knob **123***g* and sets it to the desired spell represented by magic symbols **204** (FIG. **15**D). Then, using only a single wand activation circuit and a single learned wand motion, the user causes an RF or IR signal to be transmitted, carrying the unique command signal/data to an RF or IR receiver, thereby controlling or activating an associated effect. Alternatively, a potentiometer may be used in conjunction with an ND converter circuit instead of rotary switch **202** for selecting wand functions/spells. The wand **100***g* in all other material respects is essentially the same as wand **100***b* illustrated and described above in connection with FIG. **8**. Note that the handle **120***g* and knob **123***g* are slightly modified, as these elements are preferably uniquely customized/personalized for each wand and/or wand user as will be discussed in more detail later.

FIG. **16**A is a schematic illustration of a further alternative embodiment of an interactive wand toy including optional touch sensor elements for selecting one or more wand spell commands. Wand **100***h* is essentially the same as wand **100***f* illustrated and described above in connection with FIGS. **14**A and **14**B, except for the substitution of touch sensor elements **208**, **210**, **212** for tilt sensors **192**, **194**.

Touch sensor elements **208**, **210**, **212** (represented in the accompanying schematic as S3, S**4**, S5) comprise solid-state electronic switches (no buttons or moving parts) that are activated by the simple touch of a finger. Most preferably, these are solid state touch switches of the type illustrated and described in U.S. Pat. No. 4,063,111 to Dobler et al., the entire contents of which are incorporated herein by reference. As illustrated in FIG. **16**B, each touch switch contact element **208**, **210**, **212** is preferably formed from a pair of conductive electrodes **211** surrounded by, and preferably flush with, an insulating material **213**. If desired, the electrodes **211** may be shaped in the form of magic symbols or other shapes consistent with a desired magic theme, as illustrated. During use, the user's finger **217** is placed over the pair of electrodes **211** and thereby forms a portion of an electronic circuit to change the state of a corresponding solid state electronic switching device Q**1**, Q**2**, Q**3** in communication therewith, such as a MOSFET or PNP transistor. The touch sensor is thereby actuated.

Each touch sensor preferably controls one data input bit of the RF/IR module data bus (e.g., S**3**, S**4**, S**5**). One or more touch switches may be activated during a single wand transmission. Thus, those skilled in the art will readily appreciate that eight possible combinations of touch switch activations are possible corresponding to eight unique command input data sets as follows: ON/ON/ON; OFF/OFF/ON; ON/OFF/ON, OFF/ON/ON, ON/ON/OFF; OFF/OFF/OFF; ON/OFF/OFF, and OFF/ON/OFF These eight sensor states can represent, for example, eight unique command signals sent using the RF/IR module **150***h*.

As illustrated in FIGS. **16**C and **16**D, a user may select a spell by touching one or more selected magic symbols. Then, while holding the fingers over the selected magic symbols and using only a single wand activation circuit and a single learned wand motion, the user causes an RF or IR signal to be transmitted, carrying the unique command signal/data to an RF or IR receiver, thereby controlling or activating an associated effect.

Optionally, wand **100***h* includes a magnetic tip **216**, as illustrated in FIG. **16**A. This can be especially useful and entertaining for close-range activation of various play effects, such as turning lights on/off, triggering special sound and/or lighting effects. For example, FIGS. **17**A-**17**B are time-sequenced illustrations of one embodiment of a magnetically actuated lighting effect using the interactive wand toy **100***h* with optional magnetic tip **216**. A magnetic reed switch **218** is provided in series between the desired lighting effect **220** and a power source (V+). The reed switch is constructed in the normal fashion. Contacts **222**, **224** are normally open and, thus, the lighting effect **220** is in its OFF state. But, when the magnetic tip **216** of wand **100***h* is brought into relatively close proximity (2-3 cm) with the reed switch **218**, contact elements **222**, **224** are magnetized by the magnetic field lines and are drawn toward each other. This causes the contacts **222**, **224** to immediately attract, closing the gap and completing the circuit to turn on the lighting effect **220**. Of course, those skilled in the art will appreciate from the disclosure herein that various relays, power controllers and the like may be required or desirable to provide adequate control of larger, more complex effects. But all such effects, no matter how small/simple or large/complex, may be triggered with a simple reed switch **218** and a wand **100***h* having a magnetic tip **216**, as described above.

The magnetic tip **216** is especially useful and synergistic in combination with the other disclosed functions and features of wand **100***h*. Thus, for example, as illustrated in FIG. **17**C, a desired lighting effect is controlled by RF/IR receiver **250**, which is adapted to receive an RF and/or IR command signal from wand **100***h*. The RF/IR receiver **250** (and/or the lighting effect **220**) is also controlled by series-connected magnetic reed switch **218**, as illustrated and described above (FIGS. **17**A, **17**B). Desirably, this allows a user to use the wand **100***h* and the magnetic tip **216** thereof to select one or more effects he or she wishes to control or activate. For example, the closure of the magnetic reed switch **218** sends an activation signal to RF/IR receiver **250**. In response, the receiver initiates a timer (e.g., 5-10 seconds) wherein its RF and/or IR receiver circuitry is activated and ready to receive one or more transmitted commands for controlling the associated effect **220**. Thus, a user may select to control the lighting effect **220** by activating the reed switch **218** with the magnetic tip **216** of wand **100***h*. Then the user may cast a spell (cause the wand **100***h* to transmit an RF or IR command signal) that commands the RF/IR receiver **250** to turn the lighting effect ON or OFF, to change the lighting effect (e.g., change its color or intensity), and/or launch a related effect (e.g., simulated levitation of the lighting source or other desired effects). In this manner, users can maintain direct and precise control over any number of individual play effects as may be desired. The wand **100***h* in all other material respects is essentially the same as wand **100***f* illustrated and described above in connection with FIG. **14**. Note that handle **120***h* and knob **123***h* are slightly modified, as these elements are preferably uniquely customized/personalized for each wand and/or wand user as will be discussed in more detail later.

While it is particularly preferred to provide batteryless RF-enabled, RFID-enabled or IR-enabled wand **100**, those skilled in the art will recognize from the disclosure herein that the invention may be carried out in a variety of other ways that incorporate some or all of the inventive features disclosed and described herein. For example, wand activation circuit **115** may be implemented in a variety of other gaming and entertainment applications such as, for example, a wireless or hard-wired wand input device for a video game, computer game or home game console, an arcade or redemption challenge device, home-operated amusement device using simple bells and buzzers, or the like. Alternatively, some or all of the various circuitry and components described herein above may be externally implemented such that the wand **100** may not be entirely self-contained, but may rely on certain external components and circuitry for some or all of its functionality. Alternatively, some or all of the various circuitry and components described herein can be implemented in a user-wearable format such that various interactive play effects and the like, as described herein, may be actuated through particular hand or arm motions without the use of a wand.

Proximity Sensor

In yet another embodiment, the wand **100** further comprises a proximity sensor usable to provide a "hover" effect that is indicative of the initialization of a control interlock. When the proximity sensor in the wand **100** is moved within a particular distance of a receiver, such as the RF/IR receiver **150**, and/or an effects controller, a "hover" effect occurs, such as, for example, the turning on of a light, the movement or vibration of an object, or any other perceptible signal (visual or audible) that notifies the user that a play effect may be initiated.

For instance, one embodiment of the invention may include a play effect that comprises the moving of a book. When the user brings the wand **100** within a predetermined distance from the book (e.g., one meter), the proximity sensor in the wand **100** causes the wand to output a command signal to a receiver and/or effects controller near the book to initiate a control interlock and to generate a "hover" effect, such as the turning on of a light. At this point, the user is notified that he or she may then cast the appropriate spell, such as by appropriately motioning the wand **100**, which causes the book to move. If the user attempts to cast the spell outside of the predetermined distance, the book does not move. This is because the appropriate control interlock is not initiated between the wand **100** and the receiver and/or effects controller.

Furthermore, the foregoing described "hover" effect may be used with passive RFID technology to conserve energy or battery power of the wand **100**. In one embodiment, the wand **100** comprises a passive RFID circuit in addition to an activation circuit (e.g., activation circuit **115** of FIG. **1**) and may operate in an "active" or a "sleep" mode. During the sleep mode, the activation circuit does not engage in significant activity, which reduces the energy consumption of the wand **100**. In addition, during the "sleep" mode, the user may not be able to cast spells with the wand **100**. When the passive RFID circuit of the wand **100** is brought with a certain range of an RF transmitter, such as positioned near the effects controller, the passive RFID circuit receives the transmitted RF signal and "awakens" the wand activation circuit into the "active" state. At this point, the user is able to engage in spell casting, such as by motioning the wand, as is described herein. In further embodiments, a perceptible signal, such as a light or a noise, alerts the user when the wand **100** awakens to an "active" mode.

Although disclosed with reference to particular embodiments, a skilled artisan will recognize from the disclosure herein a wide variety of methods and/or devices usable to cause a "hover" effect. For example, the user may use certain voice commands, such as a particular magic word or phrase, to cause the "hover" effect and to initiate a control interlock. In other embodiments, an RFID tag in the wand **100**, the receiver, and/or the effects controller is used to initiate the "hover" effect. In yet other embodiments, the proximity sensor is located remote to the wand **100**, such as near or in the receiver and/or effects controller.

Wand Operation

A magic wand as disclosed and described herein may be used to cast an infinite possibility of "spells" or commands based on a single wand activation circuit, a single learned wand motion and only a few unique wand command signals selected using any of the various circuits and structures described above in connection with FIGS. **14**-**16** (of course more complex operations are also possible and desirable). For example, using the wand **100***g* illustrated and described in connection with FIGS. **16**A-**16**D a user can easily transmit three distinct command codes selected by each of the three touch sensors **108**, **110**, **112**. Touching either the "+" or the "−" symbols and waving the wand in the required motion triggers the internal wand activation circuit and causes the wand to transmit a radio frequency (RF) or infrared (IR) signal corresponding to an "ON/CAST" or "OFF/BLOCK" command or spell, respectively. This can be useful, for example, for turning on/off various play effects over long distances (up to 100 meters) and for basic game play such as spell casting competitions, target practice, and the like.

If it is desired to provide signal directionality so that the command signal or spell can be aimed or cast at various particular selected play effects or objects, then a directional signal source such as IR and/or directionalized RF is preferably selected. Alternatively, a combination of directional (e.g., IR) and omni-directional (e.g., RF) signal sources may be used effectively to provide a desired directional spell-casting capability. For example, a momentum-actuated switch or accelerometer (not shown) internally disposed within the tip of wand **100** can be used to activate a directional signal source (e.g., a light bulb or L.E.D. shining a beam or cone of light) when a predetermined momentum force or acceleration is reached. Such a wand with internal wand activation circuitry and/or a directional signal source may replace, for example, a gun or a rifle in a conventional shooting gallery or target game such as disclosed in U.S. Pat. No. 4,296,929 to Meyer et al. and U.S. Pat. No. 5,785,592 to Jacobsen, both of which are incorporated by reference herein in their entireties.

Waving and activating the wand while touching the "*" symbol preferably initiates the beginning of a "complex" spell comprising multiple combinations of the first two (base-2 coding) or all three wand motions (base-3 coding). Of course, those skilled in the art will appreciate that with three touch sensors, up to base-8 coding is possibly by including combinations of simultaneously activated sensors. Thus, various spell "recipes" or incantations can be described and carried out using a sequence of individual commands and corresponding wand motions as represented, for example, by the three distinct magic symbols. Table 3, below, illustrates some examples of complex spells/commands that are possible using base-3 coding.

TABLE 1

Spell Formula	Effect
+	"on" or "cast spell"
–	"off" or "block spell"
*	"start complex spell"
*+	"move object"
*–	"stop object"
–+	"start/increase levitation"
––	"stop/decrease levitation"
++	"unlock/open door"
***–	"lock/close door"
*++	"Fire Spell"
*+–	"Block Fire spell"
*+++	"Ice Spell"
*++–	"Block Ice Spell"

Using up to 6 combinations of 2 wand motions (base-2), wand users can produce 126 different spells. Using up to 6 combinations of 3 wand motions (base-3), wand users can produce 1092 different spells. Using up to 6 combinations of 8 wand motions (base-8) produces 299,592 different possible spells. There is virtually no limit to the number of different spells that can be created and executed in this fashion. Preferably, once a complex spell is initiated and during each further step thereof a timer is initiated by the associated active receiver module and/or effects controller. If an additional command signal is not received within a predetermined time period (e.g. 0.5-3 seconds) the complex spell is considered "completed" and the effects controller actuates the appropriate relay to trigger whatever appropriate effect(s) correspond to the complex spell received. If the spell is incomplete or is inaccurate in any way, preferably only a "swoosh" or similar sound effect is triggered indicating that a spell was cast but did not work.

If desired, the active receiver module or associated effects controller can also be configured to give users audible and/or visual cues as each complex spell is being cast. This is in order to help users cast complex spells and help them identify when they have made a mistake or if they are about to cast the wrong or an unintended spell. For example, various themed feedback effects such as glowing lights, halo effects or escalating sound effects can be provided as each step in a complex spell is successfully completed. Again, this helps users learn the spells and understand where they perhaps went wrong in casting a particular spell. It also helps users discover and learn new spells by trial and error experimentation and by memorizing various spell sequences/commands that are observed to produce desired effects.

Preferably, users participate and advance in an interactive magic experience or game over time (e.g., weeks, months or years) according to a predetermined progression of gaming levels, wand levels and/or experience levels. For example, the various RF receivers disposed within a compatible play space could be programmed so that users of Level-1 wands may only be able to cast spells by actually touching their wands to whatever object they wish to control/actuate. Users of Level-2 wands would be able to cast simple (e.g., on/cast and off/block) spells over short and medium range distances, but not complex spells. Users of Level-3 wands would be able to cast simple spells (e.g., on/cast and off/block) and some complex spells (e.g., spells requiring up to 3 wand motions) over short, medium and long range distances, but not more complex spells requiring 4 or more wand motions. Users of Level-4 wands would be able to cast all types and varieties of simple and complex spells over short, medium and long distances using any number of wand motions as desired. Certain "master" level users may also be able to program or define their own spells and share them with other users. There is no limit to the number and complexity of spells and corresponding special effects that may be created.

Wand levels can easily be set and changed, for example, by accessing the internal circuitry of each wand and flipping various dip switches to change the address or coding of the internal RF/IR transmitter. Alternatively, within a play facility wand levels may be set and stored at the receiver/controller level by tracking each wand unique ID code (UPIN/UGIN) and using a computer and an indexed data-base to look up the corresponding wand level and any other relevant gaming information associated with each unique UPIN/UGIN. Preferably, when a user reaches the appropriate number of points or experience for advancement to the next level, a special congratulatory effect is actuated and the user is thereby notified that he or she has earned additional magic powers. If desired, a short graduation ceremony may be presided over by a "Grand Wizard" while the user's wand is upgraded with new magic powers (e.g., insertion of new electronics and/or adjustment of various dip switches, circuit jumpers, combinations of the same or the like).

Wand Fabrication, Assembly and Detailing

One particularly exciting and rewarding aspect of an immersive interactive magic experience in accordance with the present invention is providing users with an opportunity to select, build and/or decorate their own magic wands. Accordingly, preferably all or most of the wand components are standardized, modularized and interchangeable so that various prefabricated wand components and starting materials can be stocked (e.g., in a "wizards workshop") and individually purchased by users to create an endless variety of unique and individualized finished wands having evolving powers, abilities and/or aesthetics.

For the most fully immersive experience possible it is most desirable that users are not distracted by the underlying technology that makes the wand work, but simply enjoy the immersive fantasy experience of practicing, performing and mastering "real" magic using a "real" magic wand. Thus, preferably most, if not all, of the wand components are simple in outward appearance and preferably contain no conspicuous outward manifestations (or have only minimal outward manifestations) of the technology within. Wand materials and components fabricated from natural or simulated natural materials, such as wood, bone, leather, minerals (metals) and crystals are particularly preferred, although certainly not required.

The base wand component comprises the wand shaft **110**. This may be a hollow plastic, wood or metal shaft provided in various materials and colors. For beginners or entry level users, a finished wand may be constructed by simply selecting a wand shaft **110** and then fitting it with one or more magnetic end caps **216**, as illustrated. This provides a entry level wand (Level-1) that can be used to activate a variety of simple effects such as illustrated and described above in connection with FIGS. **17**A-**17**C. If desired, a small wood lathe **230** can be used to create a custom wand handle **120** fabricated from a selected wood stock and a user's choice of any one of a number of available template patterns. If further desired, the end of the handle may be center-drilled to accommodate a threaded stud **121**, bolt or other means for removably securing a selected decorative metal, wood and/or crystal knob **123***a*-**123***f*. Such knobs may comprise, for example, any one of a number of standard, internally threaded cabinet knobs or drawer-pulls such as available from Emtek Products Inc. A Level-1 wand constructed in this fashion preferably facilitates basic game play within a compatible play facility, but is not fully functional and, therefore, may not be capable of achieving some of the more desirable play effects or play experiences available.

The next level wand (Level-2) would preferably include, in addition, a simple passive RFID transponder **118** inserted and secured at one end thereof. The transponder **118** provides relatively short-range RF communications and also stores a unique person identifier number ("UPIN") and an optional unique group identifier number ("UGIN"). The UPIN and UGIN may be used to identify and track individual wands and play participants. The RFID transponder **118** also stores certain information identifying each play participant and/or describing certain powers or abilities possessed by an imaginary role-play character represented by the wand. These stored character attributes may be easily and conveniently transported with the wand to various compatible play facilities, games, video games, home game consoles, hand-held game units, and the like. If desired, the transponder **118** may be encapsulated in a colored epoxy, Lucite or the like and thereby disguised as a natural crystal or mineral/stone. A Level-2 wand preferably facilitates basic and intermediate game play within a compatible play facility. It has more functionality than a Level-1 wand, but is still not fully functional and, therefore, may not be capable of achieving some of the most desirable play effects or play experiences available.

The next level wand (Level-3) would preferably include, in addition, an active RF/IR module and associated wand activation circuitry for wirelessly casting a simple spell (e.g., ON/OFF) over longer distances. For example, this would be similar to the wand **100***d*, illustrated and described above in connection with FIG. **12**. Preferably, the wand would be self powered, requiring no batteries or other replaceable internal power source. However, if replaceable batteries are desired, they may optionally be encapsulated in a colored epoxy, Lucite or the like and thereby disguised and sold in the form of a natural "energy crystal" or mineral/stone. A Level-3 wand preferably facilitates basic, intermediate and some advanced game play within a compatible play facility. It has more functionality than a Level-1 and Level-2 wand and can cast simple spells over long distances, but is not able to cast more complex spells. Therefore, it may not be capable of achieving some of the most advanced and desirable play effects or play experiences available.

The highest level wand (Level-4) would preferably include, in addition, circuitry and/or structure(s) for selecting and casting more advanced and/or complex spells (e.g., ON/OFF, increase/decrease, UP/DOWN, change colors, simulated levitation, or the like). For example, this would be similar to the wands **100***f*-**100***h*, illustrated and described above in connection with FIGS. **14-16**. Preferably, the wand would be self powered, requiring no batteries or other replaceable internal power source. A Level-4 wand preferably facilitates basic, intermediate and all advanced game play within a compatible play facility. It has more functionality than a Level-1, Level-2 and Level-3 wand and can cast a variety of simple or complex spells over long distances to achieve the most advanced and spectacular magical play effects.

Preferably, in all cases described above, the wand shaft **110**, handle **120** and/or knob **123** may be further decorated and/or individualized, as desired, with various monograms, engravings, stickers, stains, custom paint and the like, to suit the tastes of each individual user. For example, various assembly and fabrication stations may preferably be provided within a dedicated "workshop" area whereby wand purchasers may personally attend to the selection, fabrication, assembly and final detailing of their personal wands. Similarly, wand "kits" may also be selected, packaged and sold whereby purchasers can assemble and decorate their own wands in the convenience of their own home using the wand components, materials and decorative elements illustrated and described above. FIGS. **19**A-**19**P illustrate various examples of wands, wand handles or grips, wand add-ons, and wand knobs that have been fabricated, assembled and detailed in a manner as described above.

RFID Tags/Transponders

Many of the preferred embodiments of the invention illustrated and described above are RFID-enabled—that is, they utilize RFID technology to electrically store and communicate certain relevant information (e.g., UPIN and UGIN, game levels, points, combinations of the same or the like) and/or to wirelessly actuate or control various magical play effects. RFID technology provides a universal and wireless medium for uniquely identifying objects and/or people and for wirelessly exchanging information over short and medium range distances (10 cm to 10 meters). Commercially available RFID technologies include electronic devices called transponders or tags, and reader/writer electronics that provide an interface for communicating with the tags. Most RFID systems communicate via radio signals that carry data either uni-directionally (read only) or, more preferably, bi-directionally (read/write).

Several examples of RFID tags or transponders particularly suitable for use with the present invention have been illustrated and described herein. For example, in the particular preferred embodiments illustrated and described above, a 134.2 kHz/123.2 kHz, 23 mm glass transponder is preferably selected, such as available from Texas Instruments, Inc. (http://www.tiris.com, e.g., Product No. RI-TRP-WRHP). As illustrated in FIG. **21**A, this transponder basically comprises a passive (batteryless) RF transmitter/receiver chip **240** and an antenna **245** provided within an hermetically sealed vial **250**. A protective silicon sheathing **255** is preferably inserted around the sealed vial **250** between the vial and the inner wall of the tube **110** to insulate the transponder from shock and vibration. If desired, the RFID transponder **118** may be modified to provide an optional external interrupt/disable line **260**, such as illustrated in FIG. **21**A and as described in more detail above in connection with FIGS. **1** and **5**.

However, those skilled in the art will readily appreciate from the disclosure herein that the invention is not limited to the specific RFID transponder devices disclosed herein, but may be implemented using any one or more of a wide variety of commercially available wireless communication devices such as are known or will be obvious from the disclosure herein to those skilled in the art. These include, without limitation, RFID tags, EAS tags, electronic surveillance transmitters, electronic tracking beacons, Wi-Fi, GPS, bar coding, and the like.

Of particular interest for purposes of practicing the present invention is the wide variety of low-cost RFID tags that are available in the form of a printed circuit on a thin, flat adhesive-backed substrate or foil. For example, the 13.56 MHz RFID tag sold under the brand name Tag-it™ and available from Texas Instruments, Inc. (http://www.tiris.com, Product No. RI-I03-110A) has particular advantages in the context of the present invention. Paper thin and batteryless, this general purpose read/write transponder is placed on a polymer tape substrate and delivered in reels. It fits between layers of laminated paper or plastic to create inexpensive stickers, labels, tickets and badges. Tag-it™ inlays have a useful read/write range of about 25 cm and contain 256 bits of on-board memory arranged in 8×32-bit blocks which may be programmed (written) and read by a suitably configured read/write device. Such tag device is useful for storing and retrieving desired user-specific information such as UPIN, UGIN, first and/or last name, age, rank or level, total points accumulated, tasks completed, facilities visited, etc. If a longer read/write range and/or more memory is desired, optional battery-powered tags may be used instead, such as available from AXCESS, Inc. and/or various other vendors known to those skilled in the art.

Another RFID tagging technology of particular interest for purposes of practicing the present invention are the so-called "chipless" RFID tags. These are extremely low-cost RFID tags that are available in the form of a printed circuit on a thin, flat adhesive. These tags are similar in size, shape and performance to the Tag-it™ inlays described above, except that these tags require no on-board integrated circuit chip. Chipless RFID tags can be electronically interrogated to reveal a pre-encoded unique ID and/or other data stored on the tag. Because the tags do not contain a microchip, they cost much less than conventional RFID tags. An adhesive-backed chipless RFID tag with up to 10 meters range and 256 bits of data, can cost one tenth of their silicon chip equivalents and typically have a greater physical performance and durability. For example, a suitable chipless RFID tag is being made available from Checkpoint Systems under its ExpressTrak™ brand. Very inexpensive chipless RFID tags (and/or other types of RFID tags) may also be directly printed on paper or foil substrates using various conductive inks and the like, such as are available from Parelec Inc. under its Parmod VLT™ brand.

In the context of carrying out an interactive gaming experience, play experience or entertainment experience, such as the type generally disclosed and described herein, such adhesive-backed tag devices and the like are highly advantageous. They are inexpensive, disposable, and may be easily secured or applied to virtually any play object, wand, wristband, badge, card or the like, for electronically storing and retrieving desired user-specific or object-specific information. Such information may include, for example, UPIN, UGIN, object type/size/shape/color, first and/or last name, age, rank or level, total points accumulated, tasks completed, facilities visited, combinations of the same or the like. For example, FIG. **20**A illustrates one preferred embodiment of a wand toy **100***i* having an adhesive-backed RFID tag **322** secured thereon for enabling the wand **100***i* to interact with various play effects located within an RFID-enabled play facility or play environment. FIG. **20**B illustrates a second preferred embodiment of a wand toy **100***j* having an adhesive-backed RFID tag **322** secured thereon for enabling the wand **100***j* to interact with various play effects located within an RFID-enabled play facility or play environment. Similar RFID tags may also be applied to any of the other wands **100***a-h* disclosed and described herein or any other toys, play objects, jewelry, trinkets, action figures, collectibles, trading cards and generally any other items desired to be incorporated as part of an RFID-enabled gaming experience.

FIGS. **20**E and **20**F illustrate one possible preferred embodiment of a key chain trinket **321** incorporating an RFID tag **322** suitable for use in various RFID-enabled gaming and entertainment experiences as disclosed herein. Such RFID-enabled items not only make the overall gaming and entertainment experience more exciting and enjoyable, but they can create unique branding opportunities and additional lucrative revenue sources for a play facility owners/operators. Moreover, and advantageously, character attributes developed during a play a participant's visit to a local play facility are stored on the tag **322**. When the play participant then revisits the same or another compatible play facility, all of the attributes of his character are "remembered" on the tag so that the play participant is able to continue playing with and developing the same role-play character. Similarly, various video games, home game consoles, and/or hand-held game units can be and preferably are configured to communicate with the tag in a similar manner as described above and/or using other well-known information storage and communication techniques. In this manner, a play participant can use the same role play character he or she has developed with specific associated attributes in a favorite video action game, role-play computer game or the like.

Trading cards incorporating RFID tags are also particularly advantageous in the context of an interactive role-playing game such as disclosed herein. For example, FIGS. **20**C and **20**D are front and rear views, respectively, of an optional RFID-enabled trading card **325** for use within an interactive gaming experience as described herein. For example, such RFID-enabled trading cards may be used instead of or as an adjunct to the wand **100** with RFID transponder **118** as illustrated and described above in connection with FIG. **1**. Each card **325** preferably comprises a paper, cardboard or plastic substrate having a front side **328** and a back side **330**. The front **328** of the card **325** may be imprinted with graphics, photos, or any other information as desired. In the particular embodiment illustrated, the front **328** contains an image of a magical wizard character **332** in keeping with an overall magic or wizard theme. In addition, the front **328** of the card may include any number of other designs or information **334** pertinent to its use and application in the game. For example, the character's special magic powers, skills and experience level may be indicated, along with any other special powers or traits the character may possess.

The obverse side **330** of the card preferably contains the card electronics comprising an RFID tag **322** pre-programmed with the pertinent information for the particular person, character or object portrayed on the front of the card. The tag **322** generally comprises a spiral wound antenna **338**, a radio frequency transmitter chip **340** and various electrical leads and terminals **342** connecting the chip to the antenna. If desired, the tag may be covered with an adhesive paper label **344** or, alternatively, the tag may be molded directly into a plastic sheet substrate from which the card is formed. Preferably, the tag **322** is passive (requires no batteries) so that it is inexpensive to purchase and maintain. The particular tag illustrated is the 13.56 MHz tag sold under the brand name Tag-it™ available from Texas Instruments, Inc. (http://www.tiris.com, Product No. RI-I03-110A). The tag may be "read/write" or "read only", depending on its particular gaming application. Optionally, less expensive chipless tags may also be used with equal efficacy.

Those skilled in the art will readily appreciate from the disclosure herein that a variety of trading card designs having features and advantages as disclosed herein may be used to play a wide variety of unique and exciting games within an RFID-enabled play facility and/or using an RFID-enabled gaming device or game console. Alternatively, persons skilled in the art will appreciate from the disclosure herein that such games may be carried out using a conventional computer gaming platform, home game console, arcade game console, hand-held game device, internet gaming device or other gaming device that includes an RFID interface. Advantageously, play participants can use trading cards **325** to transport information pertinent to a particular depicted person, character or object to a favorite computer action game, adventure game, interactive play facility or the like. For example, a suitably configured video game console and video game may be provided which reads the card information and recreates the appearance and/or traits of particular depicted person, character of object within the game. If desired, the game console may further be configured to write information to the card in order to change or update certain characteristics or traits of the character, person or object depicted by the card **325** in accordance with a predetermined game play progression.

Advantageously, RFID-enabled character trading cards and character traits, including special powers, and the like, need not be static in the game, but may change over time according to a central story or tale that unfolds in real time (e.g., through televised shows or movies released over the course of weeks, months or years). Thus, a character trading card that may be desirable for game play this week (e.g., for its special magic powers or abilities), may be less desirable next week if the underlying character is injured or captured in the most recent episode of the story. Another significant and surprising advantage of RFID-enabled trading cards is that multiple cards can be stacked and simultaneously read by a single RFID reader even where the cards are closely stacked on top of one another and even though the reader may be hidden from view. This feature and ability creates limitless additional opportunities for exciting game complexities, unique game designs and gaming strategies heretofore unknown.

FIGS. **33**A-**33**D are front views of various alternative embodiments of possible role-play character cards for use within a Harry Potter/Hogwarts interactive play structure. See, for example, U.S. Pat. No. 6,761,637 to Weston, incorporated herein by reference, which describes an interactive play structure in the theme of a "magic" training center for would-be wizards in accordance with the popular characters and storylines of the children's book series "Harry Potter" by J. K Rowling. Role play cards **600** are preferably constructed substantially the same as the card **325** illustrated and described above in connection with FIGS. **20**C, **20**D, except with different character illustrations and/or graphics. For example, each card **600** may include a different character from a Harry Potter storyline representing a role-play character desired to be imagined by a play participant. The obverse side (not shown) includes an RFID tag, such as illustrated and described above in connection with FIG. **20**D. Alternatively, a magnetic "swipe" strip and/or other well known information storage means may be used with efficacy, so long as it is relatively compact, durable and inexpensive.

The particular size, shape and theme of the cards **600** is relatively unimportant. In the particular embodiment illustrated, the cards **600** are shaped and themed so as to be used as bookmarks for Harry Potter series books. These may be packaged and sold together with each Harry Potter book, or they may be sold separately as novelty items or the like. If desired, a hole or eyelet **610** may be provided at the top of each card **600** so as to facilitate wearing the card **600** as a pendant on a necklace **620** or as key-chain trinket. Smaller, pocket-sized cards and/or other similar RFID or magnetic transponder devices may also be used where convenience and market demand dictates. Such transponder devices are commercially available, such as from Texas Instruments, Inc. (http://www.tiris.com, e.g., Prod. Nos. RI-TRPW9WK, RI-TRP-R9QL, RI-TRP-WFOB).

Of course, those skilled in the art will readily appreciate from the disclosure herein that the underlying concept of an RFID-enabled card **325** and card game is not limited to cards depicting fantasy characters or objects, but may be implemented in a wide variety of alternative embodiments, including conventional playing cards, poker cards, board game cards and tokens, sporting cards, educational cards and the like. If desired, any number of other suitable collectible/tradable tokens, coins, trinkets, simulated crystals or the like may also be provided and used with a similar RFID tag device for gaming or entertainment purposes in accordance with the teachings of the present invention.

For example, RFID tag devices may be included on "magic articles" that may be purchased or acquired in a gaming or interactive play system. For instance, a user may purchase an invisibility cloak, magic beads, belts, and the like during an interactive play experience. The RFID tags may be used to communicate to a central database that a certain person has purchased or is possession of the tagged item. The central database may then track the tagged items and/or may cause those in possession of the tagged items to have increased "magical" skills or powers, such as additional protection from the spells "cast" by opposing players.

FIGS. **20**G and **20**H are front and rear views, respectively, of an optional or alternative RFID tracking badge or card **325** that may be used instead of or in addition to the wand **100** described above. The particular badge or card **325** illustrated is intended to be affixed or adhered to the front of a shirt or blouse worn by a play participant during their visit to suitably equipped play or entertainment facilities. The badge preferably comprises a paper, cardboard or plastic substrate having a front side **328** and a back side **330**. The front **328** of each card/badge **325** may be imprinted with graphics, photos, or any other information desired. In the particular embodiment illustrated, the front **328** contains an image of Harry Potter in keeping with the overall theme of the game. In addition, the front **328** of the badge **325** may include any number of other designs or information **334** pertinent to its application. For example, the guest's name and associated group may be indicated for convenient reference. A unique tag ID Number may also be displayed for convenient reference and is particularly preferred where the badge **325** is to be reused by other play participants.

The obverse side **330** of the badge **325** contains the badge electronics comprising a radio frequency tag **322** pre-programmed with a unique person identifier number ("UPIN"). The tag **322** generally comprises a spiral wound antenna **338**, a radio frequency transmitter chip **340** and various electrical leads and terminals **342** connecting the chip **340** to the antenna. Advantageously, the UPIN may be used to identify and track individual play participants within the play facility. Optionally, each tag **322** may also include a unique group identifier number ("UGIN") which may be used to match a defined group of individuals having a predetermined relationship—either preexisting or contrived for purposes of game play. If desired, the tag **322** may be covered with an adhesive paper label (not shown) or, alternatively, may be molded directly into a plastic sheet substrate comprising the card **325**.

RF ID Readers/Writers

In accordance with another preferred embodiment of the invention various RFID readers and associated play effects are distributed throughout an entertainment facility and are able to read the RFID tags described herein and to actuate or control one or more effects in response thereto. For example, the UPIN and UGIN information can be conveniently read and provided to an associated computer, central network, display system or other tracking, recording or display device for purposes of interacting with an associated effect and/or creating a record of each play participant's experience within the play facility. This information may be used for purposes of interactive game play, tracking and calculating individual or team scores, tracking and/or locating lost children, verifying whether or not a child is inside a facility, photo capture and retrieval, and many other useful purposes as will be readily obvious and apparent from the disclosure herein to those skilled in the art.

FIG. **21**B is a simplified schematic diagram of one embodiment of an RFID reader/writer **300** for use with the wand and RFID transponder **118** of FIG. **21**A. A preferred reader/writer device is the Series 2000 Micro Reader available from Texas Instruments, Inc. (http://www.tiris.com, e.g., Product No. RI-STU-MRD1). As illustrated, the reader/writer **300** basically comprises an RF Module **302**, a Control Unit **304** and an antenna **306**. When the distal end of wand **100** and its internally contained transponder **118** comes within a predetermined range of antenna **306** (about 20-200 cm) the transponder antenna **245** is excited by the radiated RF fields **308** and momentarily creates a corresponding voltage signal which powers RF transmitter/receiver chip **240**. In turn, the RF transmitter/receiver chip **240** outputs an electrical signal response which causes transponder antenna **245** to broadcast certain information stored within the transponder **235** comprising, for example, 80 to 1000 bits of information stored in its internal memory. This information preferably includes a unique user ID (UPIN/UGIN), magic level or rank and/or certain other items of information pertinent to the user, the wand and/or the game or play experience.

A carrier signal embodying this information is received by antenna **306** of RFID reader/writer **300**. RF Module **302** decodes the received signal and provides the decoded information to Control Unit **304**. Control Unit **304** processes the information and provides it to an associated logic controller, PID controller, computer or the like using a variety of standard electrical interfaces (not shown). Thus, the information transmitted by transponder **118** and received by reader/writer **300** may be used to control one or more associated play effects through a programmable logic controller, for example. In one embodiment, the information transmitted includes data relating to the activation of the sensors **122**, **124** of the wand **100**. In other embodiments, the transmitted information may include timing information, such as the duration of time that a sensor is activated and/or the duration of time between successive activations of the sensors **122**, **124**. Play effects, may include, for example, lighting effects, sound effects, various mechanical or pneumatic actuators and the like.

Preferably, RFID reader/writer **300** is also configured to broadcast or "write" certain information back to the transponder **118** to change or update information stored in its internal memory, for example. The exchange of communications occurs very rapidly (about 70 ms) and so, from the user's perspective, it appears to be virtually instantaneous. Thus, the wand **100** may be used to "magically" actuate and/or communicate with various associated effects by simply touching or bringing the tip of the wand **100** into relatively close proximity with the antenna **306** of a reader/writer unit **300**.

As indicated above, communication of data between a tag and a reader is by wireless communication. As a result, transmitting such data is always subject to the vagaries and influences of the media or channels through which the data has to pass, including the air interface. Noise, interference and distortion are the primary sources of data corruption that may arise. Thus, those skilled in the art will recognize that a certain degree of care should be taken in the placement and orientation of readers **300** so as to minimize the probability of such data transmission errors. Preferably, the readers are placed at least 30-60 cm away from any metal objects, power lines or other potential interference sources. Those skilled in the art will also recognize that the write range of the tag/reader combination is typically somewhat less (~10-15% less) than the read range and, thus, this should also be taken into account in determining optimal placement and positioning of each reader device **300**.

Typical RFID data communication is asynchronous or unsynchronized in nature and, thus, particular attention should be given in considering the form in which the data is to be communicated. Structuring the bit stream to accommodate these needs, such as via a channel encoding scheme, is preferred in order to provide reliable system performance. Various suitable channel encoding schemes, such as amplitude shift keying (ASK), frequency shift keying (FSK), phase shift keying (PSK) and spread spectrum modulation (SSM), are well know to those skilled in the art and will not be further discussed herein. The choice of carrier wave frequency is also important in determining data transfer rates. Generally speaking the higher the frequency the higher the data transfer or throughput rates that can be achieved. This is intimately linked to bandwidth or range available within the frequency spectrum for the communication process. Preferably, the channel bandwidth is selected to be at least twice the bit rate required for the particular game application.

FIG. **21**C is a simplified circuit schematic of the reader/writer unit **300** of FIG. **21**B. The read or write cycle begins with a charge (or powering phase) lasting typically 15-50 ms. During this phase, the RF Module **302** causes the antenna **306** to emit an electromagnetic field at a frequency of about 134.2 kHz. The antenna circuit is mainly formed by the resonance capacitor C**1** and the antenna coil **306**. A counterpart resonant circuit of the transponder **118** is thereby energized and the induced voltage is rectified by the integrated circuit **240** and stored temporarily using a small internal capacitor (not shown).

The charge phase is followed directly by the read phase (read mode). Thus, when the transponder **118** detects the end of the charge burst, it begins transmitting its data using Frequency Shift Keying (FSK) and utilizing the energy stored in the capacitor. The typical data low bit frequency is 134.2 kHz and the typical data high bit frequency is 123.2 kHz. The low and high bits have different duration, because each bit takes 16 RF cycles to transmit. The high bit has a typical duration of 130 μs, the low bit of 119 μs. Regardless of the number of low and high bits, the transponder response duration is generally less than about 20 ms.

The carrier signal embodying the transmitted information is received by antenna **306** and is decoded by RF module **302**. RF Module **302** comprises integrated circuitry **312** that provides the interface between the transponder **118** and the Control Module **304** (data processing unit) of the Reader/Writer Unit **300**. It has the primary function and capability to charge up the transponder **118**, to receive the transponder response signal and to demodulate it for further digital data processing.

A Control Unit **304**, comprising microprocessor **314**, power supply **316** and RS232 Driver **318**, handles most data protocol items and the detailed fast timing functions of the Reader/Writer Module **300**. It may also operate as interface for a PC, logic controller or PLC controller for handling display and command input/output functions, for example, for operating/actuating various associated play effects.

FIG. **21**D is a simplified schematic diagram of an alternative embodiment of an RF transceiver **300** configured for use with an optional master control system **375**. As illustrated, the transceiver **300** basically comprises an RF Module **302**, a Control Module **304** and an antenna **306**. When the distal end of wand **100** comes within a predetermined range of antenna **306** (~20-60 cm) the transponder antenna **245** (FIG. **21**A) becomes excited and impresses a voltage upon the RF transmitter/receiver chip **240** disposed within transponder **118** at the distal end of the wand **100**. In response, the RF transmitter/receiver chip **240** causes transponder antenna **245** to broadcast certain information stored within the transponder **118** comprising 80 bits of read/write memory. This information typically includes the user's unique ID number, magic level or rank and/or certain other information pertinent to the user or the user's play experiences.

This information is initially received by RF Module **302**, which can then transfer the information through standard interfaces to an optional Host Computer **375**, Control Module **304**, printer, or programmable logic controller for storage or action. If appropriate, Control Module **304** provides certain outputs to activate or control one or more associated play effects, such as lighting, sound, various mechanical or pneumatic actuators or the like. Optional Host Computer **375** processes the information and/or communicates it to other transceivers **300**, as may be required by the game. If suitably configured, RF Module **302** may also broadcast or "write" certain information back to the transponder **118** to change or update one or more of the 80 read/write bits in its memory.

FIGS. **21**E, **21**F and **21**G are simplified schematic illustrations of tag and reader operation in accordance with another embodiment of the invention. The tag **322** is initially activated by a radio frequency signal broadcast by an antenna **306** of an adjacent reader or activation device **300**. The signal impresses a voltage upon the tag antenna **338** by inductive coupling which is then used to power the chip **340**. When activated, the chip **340** transmits via radio frequency a unique identification number preferably corresponding to the UPIN and/or UGIN described above. The signal may be transmitted either by inductive coupling or, more preferably, by propagation coupling over a distance "d" determined by the range of the tag/reader combination. This signal is then received and processed by the associated reader **300** as described above. If desired, the RFID card or badge **325** may also be configured for read/write communications with an associated reader/writer. Thus, the unique tag identifier number (UPIN or UGIN) can be changed or other information may be added.

FIG. **21**H is a simplified block diagram illustrating the basic organization and function of the electronic circuitry comprising the radio frequency transmitter chip **340** of the RFID tag device **322** of FIG. **20**H. The chip **340** basically comprises a central processor **530**, Analog Circuitry **535**, Digital Circuitry **540** and on-board memory **545**. On-board memory **545** is divided into read-only memory (ROM) **550**, random access memory (RAM) **555** and non-volatile programmable memory **560**, which is available for data storage. The ROM-based memory **550** is used to accommodate security data and the tag operating system instructions which, in conjunction with the processor **530** and processing logic deals with the internal "house-keeping" functions such as response delay timing, data flow control and power supply switching. The RAM-based memory **555** is used to facilitate temporary data storage during transponder interrogation and response. The non-volatile programmable memory **560** may take various forms, electrically erasable programmable read only memory (EEPROM) being typical. It is used to store the transponder data and is preferably non-volatile to ensure that the data is retained when the device is in its quiescent or power-saving "sleep" state.

Various data buffers or further memory components (not shown), may be provided to temporarily hold incoming data following demodulation and outgoing data for modulation and interface with the transponder antenna **338**. Analog Circuitry **535** provides the facility to direct and accommodate the interrogation field energy for powering purposes in passive transponders and triggering of the transponder response. Analog Circuitry also provides the facility to accept the programming or "write" data modulated signal and to perform the necessary demodulation and data transfer processes. Digital Circuitry **540** provides certain control logic, security logic and internal microprocessor logic required to operate central processor **530**

Long Range Transmitter and Receiver

If desired, the wand **100** may also be configured for long range communications with one or more of the transceivers **300** (or other receivers) disposed within a play environment. For example, one or more transceivers **300** may be located on a roof or ceiling surface, on an inaccessible theming element, or other area out of reach of play participants. Such long-range wand operation may be readily achieved using an auxiliary battery powered RF transponder, such as available from Axcess, Inc., Dallas, Tex. If line of sight or directional actuation is desired, a battery-operated infrared LED transmitter and receiver of the type employed in television remote controls may be used, as those skilled in the art will readily appreciate. Of course, a wide variety of other wireless communications devices, as well as various sound and lighting effects may also be provided, as desired.

In many of the preferred embodiments of the invention as illustrated and described herein it is disclosed to use a radio frequency (RF) and/or infrared (IR) transmitter to send wand command signals over relatively long range distances (e.g., 10-100 meters or more). For example, wand **100**A illustrated and described in connection with FIG. **7** includes an internal RF/IR Module **150** for communicating various command signals to one or more remote RF/IR receivers and associated effects. Command signal receivers may be located, for example, on a remote roof or ceiling surface of a compatible play facility, a retail mall, restaurant, destination resort facility or even an outdoor public play area. Internal RF/IR Module **150** can comprise any number of small, inexpensive RF transmitters such as are commercially available from Axcess, Inc., of Dallas, Tex. If directionality is desired, any number of small, inexpensive infrared LED transmitters may be used, such as the type commonly employed in television remote controls, keyless entry systems and the like.

FIG. **22**A is a schematic block diagram of a particularly preferred transmitter module **150** adapted for use in accordance with the present invention. The transmitter module **150** generally comprises an RF transmitter **358** driven and controlled by a microprocessor or ASIC **350**. ASIC **350** includes address storage module **352**, data storage module **354** and shift register **356**. Address storage module **352** includes a stored address or coded value, for example, in parallel bit format, that is a preselected coded value that may be uniquely associated with a particular transmitter module **150**. Address storage module **352** applies the address coded value to an encoder, such as shift register **356** which, when enabled, encodes the coded value by converting it from parallel bit format to serial bit format which is applied to radio frequency (RF) transmitter **358**. Similarly, data storage module **354** may include coded data or commands provided by a user (e.g., via any of the various command input circuits and structures described above in connection with FIGS. **14-16**). Data storage module **354** applies the coded data values to shift register **356** which, when enabled, encodes the coded data by converting it from parallel bit format to serial bit format which is also applied to radio frequency (RF) transmitter **358**. Radio frequency transmitter **358** modulates the coded address and data values which is encoded in serial bit format onto a radio frequency carrier signal which is transmitted as an RF output signal (RF_{out}) such as via a simple loop antenna.

Application of electrical power from an internal battery source **152** (or one or more self-generating power sources as described herein) is preferably controlled via wand activation circuitry **115** such as illustrated and described above in connection with FIGS. **1-6**. Thus, transmitter module **150**, address storage module **352**, data storage module **354**, shift register **356** and/or RF transmitter **358**, are preferably only powered for a short period of time when the wand circuitry **115** is successfully actuated and a corresponding command signal is to be transmitted. Those skilled in the art will recognize from the disclosure herein that transmitter module **150** may be implemented in a variety of known electrical technologies, such as discrete electronic circuits and/or integrated circuits. An implementation employing an integrated microprocessor or an application specific integrated circuit (ASIC) **350** is shown diagrammatically in FIG. **22**A. Preferably, integrated circuitry technology and/or surface mount componentry is used to reduce the physical size of the circuit **150** such that it is able to fit within the relatively small cavity **116** of wand shaft **110** or handle **120** (see FIG. **1**).

FIG. **23**A is a schematic block diagram of receiver module **362** which operates in conjunction with transmitter module **150** previously described. Radio frequency command signals transmitted by transmitter module **150** are provided as input signals (RF_{In}) to RF receiver **363** which may comprise a simple tuned circuit with loop antenna (not shown). Command signals received by RF receiver **363** are applied to a decoder, such as shift register **364** which converts the coded value therein from a serial bit format to a parallel bit format. Address comparator **366** receives at one input the transmitter module coded address value in parallel bit format from shift register **364** and at its other input a preselected fixed or dynamically stored coded value from address storage **368**. The preselected coded value from address storage **368** corresponds to the preselected coded value of the transmitter module **150** with which receiver module **362** is associated or compatible. In other words, the preselected coded value stored in transmitter address storage **352** of transmitter module **150** is the same as or compatible with a preselected coded value as is stored in address storage **368** of receiver module **362** with which it is associated or compatible. If the coded address value in the received command signal matches all or a predetermined portion of the preselected fixed or dynamic coded value stored in address storage **368**, this coincidence is detected by address comparator **370** and is applied to restart or reset receive timer **372**. Receive timer **372** preferably has a time-out period of, for example, 0.5-3 seconds and, if it is not restarted or reset within this time period, it produces a command termination signal which tells an associated controller **374** to process the received command signals(s) and to actuate one or more corresponding play effects such as lighting effects **376**, sound effects **377** and motorized actuators **378**. In other embodiments, the receive timer **372** may determine the type and/or intensity of the play effect based on the amount of time between command signals. For example, shorter durations of time between command signals may cause higher-intensity play effects, and longer durations of time may cause lower-intensity play effects. Each of the functional elements of receiver module **362** and controller **374** receive electrical power from a suitable power source **380**, as illustrated.

In operation, a user activates circuitry **150** by appropriately waving or moving the wand. This causes electrical voltage from battery **150** to be applied across the RF transmitter module **150**, thereby causing the RF transmitter module **150** to transmit a desired command signal (RF_{Out}) including coded address and optional coded data information. This signal is received and decoded by receiver module **362** as input signal (RF_{In}). The decoded transmitter address information is compared to a fixed or dynamically stored coded value from address storage **368**. Preferably, an immediate effect such as a pulsing light or sound is actuated by controller **374** in order to provide visual and/or aural cues that a command signal was received. Receive timer **372** is initiated and the RF receiver module **362** awaits the next command signal. If no further signal is received before the time times out, then the spell is assumed to be complete and the controller **374** is instructed to process the received command signal(s) and actuate the appropriate relay(s) thereby triggering whatever appropriate effect(s) correspond to the spell received. Preferably, as noted above, if the spell is incomplete or is inaccurate only a "swoosh" or similar sound effect is triggered indicating that a spell was cast but did not work. For simple spells, a fixed coded value may be stored in address storage **368**. For complex spells, the stored coded value may be dynamically changed to match an expected or required series or progression of command signals. Alternatively, address storage **368** may be fixed and command signals may be carried and communicated to controller **374** as decoded data corresponding to data stored in data storage module **354** (FIG. **22**A).

For applications supporting multiple wands (i.e., multiple RF transmitter modules **150**) within a single play space, the address comparator **366** of receiver module **362** is preferably configured to accept either: (1) a range of valid "compatible" addresses from the set of RF transmitter modules **150**; or (2) any valid address from a list of valid addresses stored in address storage module **368**. In the first case, each transmitter module **150** within a defined group of transmitter modules (e.g., all Level-1 wands) would preferably be configured to have a coded address value having a portion of address bits that are identical and a portion of address bits that may be unique, but unique data bits as selected by each user. The receiver module **362**, upon detecting a compatible address bit sequence, decodes the data bits thereof and sets a latch selected by those particular data bits. A number of such latches, may be provided, for example, for recognizing and distinguishing further such command signals originating from multiple users and/or wands. In the second case, the receiver module **362** stores a list of specific coded values, i.e. valid addresses, in a memory, such as memory **368**, and as transmitted addresses are received, they are compared to the valid addresses in this list. Thus, only signals transmitted by RF transmitter modules that are on the list of valid addresses are accepted by receiver module **362**. In this manner, for example, command signals sent by Level-1 wands can be distinguished from command signals sent by Level-2 wands, which can be distinguished from Level-3 wands, etc.

Although the transmitter module **150** of FIG. **22**A and the receiver module **362** of FIG. **23**A are described with reference to RF technology, a skilled artisan will recognize from the disclosure herein that other types of wireless technology may also be used. For example, FIG. **22**B depicts an IR transmitter module **150'** having an IR transmitter **358'** that may be used to transmit signals such as the type commonly employed in television remote controls, keyless entry systems and the like.

The other components of the IR transmitter module **150'** may also be modified such that the IR transmitter module **150'** is capable of functioning similarly to the RF transmitter module **150** discussed with reference to FIG. **22**A. In addition, FIG. **23**B illustrates an IR receiver module **362'** having an IR receiver **363'** usable to operate with the IR transmitter module **150'** of FIG. **22**B. The other components of the IR receiver module **362'** may also be modified such that the IR receiver module **363'** is capable of functioning similarly to the RF receiver module **363** discussed with reference to FIG. **23**A.

FIG. **24** is a schematic block diagram of a portion of a receiver module **362"** including an embodiment of address comparator **370'** and of address storage **368'** particularly suited for operating with a plurality of simultaneously operating transmitter modules **150** or **150'**. For example, blocks in FIG. **24** that are the same as blocks in FIG. **23**A and described above are shown in phantom and are identified by the same numeric designation as in FIG. **23**A. Address storage **368'** includes addressable registers or memory **386** in which are stored the preselected coded identification values corresponding to the preselected coded identification value of each of a plurality of compatible RF transmitter modules **150** desired to be operably associated with receiver **362"**. Address selector **388** repetitively generates a sequence of addresses including the addresses of all the registers of addressable register **386** within a relatively short time period less than about 50-100 milliseconds. Thus the complete set of preselected stored coded values are applied to one input of coded value comparator **390** whereby the received coded identification value received and decoded at the output of shift register **364** and applied to the other input of coded value comparator **390** is compared to each one of the stored coded values of the set thereof stored in addressable register **386**.

Although the receiver module **362"** of FIG. **24** is disclosed with reference to particular embodiments, a skilled artisan will recognize from the disclosure herein a wide variety of alternative structures and uses for the receiver module **362"**. For example, the receiver module **362"** may be capable of receiving an IR signal and structured similarly to the IR receiver module **362'** of FIG. **23**B.

Comparator **370'** preferably includes a latch circuit **392** having an addressable latch corresponding to each register in addressable register **386** and that is addressed by the same address value generated by address selector **388** to address register **386**. When there is a match at the inputs of coded value comparator **390** between the received coded value and the then produced stored coded value, the occurrence of the match is stored by setting the designated corresponding latch in latch circuit **392**. If received coded identification values corresponding to all of the stored fixed coded values are received and properly decoded, then all of the latches in latch circuit **392** will be set, thereby making a "true" condition at the inputs of AND gate **294** and causing its output to become "true". This "true" signal from AND gate **294** resets receive timer **372**, as described above in connection with FIG. **23**A, and also activates a reset circuit **296** to reset all the latches of latch circuit **392** so that the comparison sequence of received coded identification values to the set of stored fixed coded values begins again. If all of the preselected received coded values are not received, then all of the latches in latch circuit **392** are not set, the output of AND gate **294** does not become "true", and receive timer **372** times out and issues the command termination signal discussed above.

FIG. **25** is a detailed electrical schematic diagram of an exemplary embodiment of transmitter module **150** illustrated and discussed above. Electrical power is provided by one or more batteries **152** and/or other power sources as illustrated and described herein. This power is preferably switched by wand activation circuit **115** and/or optional timer module **402**. Electrical power is provided via diode D**2** to the transmit timer U**1**, such as an integrated circuit one-shot multivibrator type LM555 available from National Semiconductor Corporation. The time-out interval of multivibrator U**1** is established by resistors R**2**, R**3** and capacitor C**1** which need not be high precision components. When wand activation circuit **115** is activated, a voltage is applied through resister R**1** to the gate of a transistor Q**1**. This causes electrical power to be applied from battery **152** to a five-volt voltage regulator U**4** such as a type LM78L05 also available from National Semiconductor Corporation. Alternatively, the periodic output from U**1** may be applied to the gate of a transistor Q**1** to the same effect (e.g., for sending periodic "beacon" transmissions).

Regulated voltage from regulator U**4** is applied to shift register **356** (pin **18**) and RF transmitter **358**. Shift register **356** is implemented by an encoder integrated circuit U**2** such as a 212 series encoder type HT12E available from Holtek Microelectronics in Hsinchu, Taiwan, R.O.C. Non-volatile address storage **352** is implemented by twelve single pole switches in switch packages SW**1** and SW**2** which are set to produce a twelve-bit coded value which is applied in parallel bit format to encoder integrated circuit U**2** of shift register **356**. Once set by the manufacturer or the user, the preselected coded value stored in address storage **352** is fixed and will not change absent human intervention. However, in alternative embodiments SW**2** may be replaced in whole or in part by wand command selection circuitry such as touch switches, mercury tilt switches and the like illustrated and described above in connection with FIGS. **14-16**. Such circuitry enables users to actively select and change the coded data impressed upon address lines **8-10** of encoder integrated circuit U**2**. Integrated circuit U**2** reproduces the coded address and data values in pulse-width modulated serial-bit format and applies it through diode D**1** to RF transmitter **358**. RF transmitter **358** includes a class B biased transistor Q**2** in an L-C tuned RF oscillator transmitter coupled to a loop antenna **406** for transmitting the command signal coded values (address bits coded by SW**1** and data bits coded by SW**2**) produced by encoder U**2**.

Transmitter module **150** need only employ a small antenna such as a small loop antenna and is not required to have optimum antenna coupling. In a typical embodiment, with a transmitter frequency of about 915 MHz, a transmitter peak power output of less than or equal to one milliwatt produces a transmission range R of about 20-30 meters. Other frequencies and power levels may also be employed. The low transmitter power is particularly advantageous in that it allows the size of transmitter module **150** to be made very small.

FIG. **26** is an electrical schematic diagram of an exemplary embodiment of receiver module **362** illustrated and discussed above. Power is supplied by a voltage source **410** which can be either a battery or a DC power supply. Voltage from voltage source **410** is regulated by voltage regulator circuit U**3** such as type LM78L05 to produce a regulated +5 volt power supply for the functional blocks of receiver module **362**. In operation, command signals transmitted from transmitter modules are received at loop antenna **412** and applied to RF receiver **363** including a receiver sub-circuit integrated circuit U**8** such as type RX-2010 available from RF Monolithics in Dallas, Tex. The identification signal, including the twelve bit coded value in serial-bit format is coupled from the output of receiver sub-circuit U**8** to shift register decoder and address comparator **364/366** which are implemented in an integrated circuit U**5**, such as a 212 series decoder type HT12D also available from Holtek Microelectronics. Decoder U**5** converts the coded value in serial-bit format to parallel-bit format and compares that received coded value to the preselected stored coded fixed reference value in parallel bit format determined, for example, by the positions of the twelve single pole switches in switch packages SW**3**, SW**4** of address storage module **368**.

Receive timer **372** is implemented by one-shot timer integrated circuit U**6***a* such as type 74123N and D-flip flop U**7***a* such as type 74HC74D, both of which are available from National Semiconductor Corporation of Santa Clara, Calif. When comparator **366** detects a match between the received coded value from transmitter module **150** and the coded value stored in address storage **368** it resets one-shot timer U**6***a*. If one-shot timer U**6***a* is not again reset within the time determined by timing resistor R**8** and timing capacitor C**9**, U**6***a* then sets flip-flop U**7***a* and its Q output becomes low thereby applying a voltage input to controller **374** signifying the end of a transmitted simple or complex spell. Controller **374** then processes the received command signal or signals (e.g., stored in a stack register) and appropriately operates one or more associated play effects **376**.

Those skilled in the art will appreciate that the switch positions of the twelve switches SW**1**, SW**2** of transmitter module **150** correspond to the switch positions of the corresponding twelve switches SW**3**, SW**4** of receiver module **362**. These preset values may be fixed or dynamic, as discussed above. The twelve-bits available for storing coded values may be apportioned in a convenient way, for example, into an address portion and into a data portion. For example, the twelve-bit coded value can be apportioned into a ten-bit address portion (1024 possible combinations) and a two-bit data portion, which would accommodate up to four different transmitter command signals. If desired, the ten-bit address portion can be further divided into various logical portions representing, for example, the designated wand level (e.g., 1, 2, 3 or 4), special acquired magic powers or skills, experience levels and the like. This coded data would preferably be shared and coordinated between all transmitter modules **150** and receiver modules **362** such that each wand effectively would have its own unique powers and abilities as represented and identified by the coded address data. Thus, certain receivers and associated play effects would not be actuated by certain wands unless the address coding of the transmitter module thereof is coded with the appropriate matching data. In addition, the timing between received signals may be used to determine the appropriate play effect or intensity of a play effect caused by operation of the wand **100**. Persons skilled in the art will recognize also that recoding of transmitter modules is a convenient way to provide for advancement of game participants within an interactive gaming experience. For example, this can be accomplished manually (e.g., by flipping dip switches SW**1**/SW**2**) or automatically/wirelessly (e.g., via RF programmable code latching circuitry, not shown).

While the foregoing embodiments have been described in terms of a radio frequency (RF) transmission between a transmitter module **150** and receiver module **362**, various alternative embodiments could also readily be implemented such as, for example, replacing (or complimenting) RF transmitter and receiver set (**358**, **363**) with an appropriately selected infrared (IR) transmitter and receiver set or a laser or light system. The IR or laser system would have particular advantage where, for example, it is desired to provide directional control of a transmitted command signal such as may be useful for directional spell casting, target practice, and wand-based shooting galleries.

Light-Activated Interactive Play System

For example, FIG. **27** illustrates an exemplary embodiment of a light-activated interactive play system **414** for use with embodiments of the invention utilizing laser technology. As shown in FIG. **27**, the interactive play system **414** comprises the magic wand **100** having a light emitting module **416**, a display device **418**, an image preparation device **420**, a camera **422**, and a control system **423**.

The light emitting module **416** of the wand **100** advantageously emits a directional signal, such as, for example, visible or infrared light. In one embodiment, the light emitting module **416** comprises a semiconductor laser. The signal output from the light emitting module **416** is emitted from an end opening of the wand **100** in a direction substantially parallel to the wand body. The signal may be generated from particular motions of the wand **100**, as described herein, or from other input from the user.

In one embodiment, the user operates the wand **100** such that the signal emitted from the light emitting module **416** is directed to the display device **418**. The display device **418** may comprises any device, apparatus or medium usable to intercept, reflect, and/or capture the signal emitted from the light emitting module **416** at an arbitrary position on the display device. In one embodiment, the display device **418** comprises a screen. In other embodiments, the display device **418** may comprise a wall, a mist, a door, a transparent surface, or the like.

Furthermore, the illustrated interactive play system **414** comprises the image preparation device **420**, which operates to cause at least one image to appear on the display device **418**. In one embodiment, the image preparation device **420** projects a video image and/or a still image onto the display device **418**. For example, the image preparation device **420** may comprise a video projector, an LCD projector, or the like. In other embodiments, the image preparation device **420** may comprise multiple devices usable to project or to cause an image to appear on the display device **418**. A skilled artisan will recognize from the disclosure herein a wide variety of objects, characters, and/or images that may be projected on the display device **418**. For instance, the image preparation device **420** may project the image of mythical creatures, such as a dragon or a unicorn; magical objects, such as a flying carpet; or fantasy characters, such as a wizard or an elf; combinations of the same or the like.

In the illustrated embodiment, the display device **418** comprises a translucent material and is arranged in front of the image preparation device **420**. In such an arrangement, the user's view of the image preparation device **420** may be partially or entirely obstructed by the display device **418**. In other embodiments, the image preparation device **420** may be located near, to the side of, or in front of the display device **418** so long as an image may appear on the display device **418**. In yet other embodiments, the image preparation device **420** is electrically coupled to the display device **418** through a wired or wireless transmission medium so as to cause images to appear on the display device.

In an embodiment, the camera **422** is directed at the display device **418** and advantageously captures, detects and/or records the arbitrary position of the signal emitted from the light emitting module **416** as the signal is intercepted by the display device **418**. For example, the camera **422** may comprise a high-speed still camera or a specialized video camera used to take periodic or continuous photographs of a surface of display device **418**. In an embodiment of the invention in which the light emitting module **416** outputs an infrared signal, the camera **422** is configured to record the infrared signal as it is intercepted by the display device **418**. The camera **422** advantageously outputs a signal based on the captured image data to the control system **423**, which captured image data includes information indicative of the position of the signal output by the light emitting module **416**. In yet other embodiments, multiple cameras **422** are used in the interactive play system **414** to capture, detect, or record the position of the light emitting module signal as it is intercepted by the display device **418**. For example, multiple cameras **422** may be directed at different sections of the display device **418** and/or may record or capture data from different angles.

In one embodiment, the control system **423** advantageously communicates with at least the image preparation device **420** and the camera **422**. For example, the control system **423** may comprise a general purpose or a special purpose processor. However, an artisan will recognize that the control system **423** may comprise an application-specific integrated circuit (ASIC) or one or more modules configured to execute on one or more processors.

The control system **423** receives and processes the image data received from the camera **422**. In one embodiment, the control system **423** analyzes the position and/or movement of the signal from the light emitting module **416** to determine modifications to be made to the subsequent images to be produced by the image preparation device **420**. For example, the control system **423** may determine from the image data that a user has cast a certain "spell" by motioning the wand **100**, and therefore the light emitting module **416**, in a particular recognizable pattern. The control system **423** may make this determination by tracking the movement(s) of the light emitting module signal across the display device **418**, which movement is recorded in the image data output from the camera **422**.

For example, the control system **423** may initially command the image preparation device **420** to project an image of a brick wall onto the display device **418**. The user, who sees the image of the brick wall, points his or her wand **100** toward the brick wall such that the light emitting module **416** outputs a signal, such as a red dot caused by a laser, onto the brick wall (and the display device **418**). The user then motions the wand in a particular pattern, such as is described herein, to cause a desired motion of the red dot across the display device **418**. The camera **422** records this movement in its image data, which is output to the control system **423** for processing. If the control system **423** determines from the image data that a certain spell has been cast, such as a "move wall" spell, the control system **423** causes the image preparation device **420** to project an image of the wall disappearing or moving out of the path or view of the user.

Although the interactive play system **414** is disclosed with reference to particular embodiments, a skilled artisan will recognize from the disclosure herein a wide variety of alternatives usable with the system **414**. For example, the display device **418** may comprise a large liquid crystal display (LCD) screen coupled to an image preparation device **420** comprising a digital video source, such as a memory. Furthermore, sensors, such as optical or infrared sensors, usable to detect the position and/or movement of the light emitting module signal may be used in place of, or in combination with, the camera **422**.

In yet another embodiment, the control system **423** may be in communication with a central system or database and/or various receivers capable of causing one or more play effects. Thus, the control system **423** may, in response to the signal emitted from the light emitting module **416**, control or cause play effects other than modifications to the image on the display device **418**. For example, the control system **423** may command a light to turn on or a book to open based on the signal captured by the camera **422**.

FIG. **27**A depicts yet another embodiment of an interactive system for use with light-activation. As shown, a light-activated interactive play system **414'** includes similar components as the interactive play system **414** of FIG. **27**. In particular, the illustrated interactive play system **414'** includes the camera **422** that advantageously captures, detects and/or records the position of a signal emitted from the light emitting module **416** of the wand **100**. In one embodiment, the camera **422** is located within a substantially enclosed area, such as, for example, a room, and detects the signal emitted from the light emitting module **416** within the room and/or directed at objects or effects within the room. In other embodiments, multiple cameras **422** are located within a single room.

The camera **422** communicates with a control system **423'**. Similar to the control system **423** of FIG. **27**, the control system **423'** receives and processes the image data received from the camera **422**. For example, the control system **423'** may analyze the position and/or movement of the signal from the light emitting module **416** within a room. In one embodiment, the control system **423'** advantageously communicates with one or more effects, such as through wired or wireless communications, to control or trigger the effects based on the image data from the camera **422**. For example, as illustrated in FIG. **27**A, the interactive play system **414'** includes effects such as a chair **424**, a bookshelf **425** having at least one book **426**, and a magic hat **427** with flowers **428**.

An embodiment of a method for interactive game play will now be described with reference to FIG. **27**A. A user or game participant enters a room having the interactive system **414'**. The user then maneuvers his or her wand **100** such that the light emitting module **416** emits its signal in a certain direction and/or pattern, which signal is captured by the camera **422**. The control system **423'** then receives image data from the camera **422** that includes information relating to the position and/or movement of the signal within the room. Using this image data, the control system **423'** triggers and/or controls at least one special effect.

For example, in one embodiment, if the user directs the signal from the light emitting module **416** toward the chair **424**, the control system **423'** causes the chair to "levitate" or to move. If the user directs the signal from the light emitting module **416** toward the bookshelf **425**, the control system **423'** may cause the book **426** to move or to open. If the user directs the signal from the light emitting module **416** toward the magic hat **427**, the control system **423'** may cause the flowers **428** to appear. Each of these described special effects may be controlled by associated effects controllers, such as motors and/or processors, that are in communication with the control system **423'**. In addition, a skilled artisan will recognize from the disclosure herein a wide variety of special effects usable with the interactive system **414'**. For example, the control system **423'** may trigger a cuckoo clock, a light to turn on, an inanimate object to speak, and so forth.

In yet other embodiments of the invention, such as illustrated in FIG. **27**B, the user performs a predetermined pattern or movement of the wand **100** to initiate a "magic spell." The movement of the wand **100** causes a corresponding movement of the signal emitted by the light emitting module **416**, which signal is captured by the camera **422**. The control system **423'** then processes the image data received from the camera **422** to determine which "spell" was cast and to cause or trigger the special effect(s) associated with the particular spell.

Competitive Games and Play Effects

It will be apparent to those skilled in the art from the disclosure herein that the invention disclosed and described herein facilitates a plethora of new and unique gaming opportunities and interactive play experiences heretofore unknown in the entertainment industry. In one embodiment the invention provides a unique play experience that may be carried out within a compatible play facility, retail space and/or other facility utilizing a wand as disclosed and described herein. With a wand or other similarly enabled device, play participants can electronically and "magically" interact with their surrounding play environment(s) to produce desired play effect, thereby fulfilling play participants' fantasies of practicing, performing and mastering "real" magic.

For example, FIG. **28** illustrates one preferred embodiment of a wand-actuated play effect comprising a player piano **429** that is adapted to be responsive to or controlled by an RF command signal transmitted by magic wand toy **100**. Those skilled in the art will readily appreciate that an RF receiver and associated controller, such as disclosed and described herein, can easily be concealed within the piano **429** and/or in the vicinity thereof such that it electronically interfaces with and directs various selected control circuitry associated with the piano **429**. These may include, for example, circuitry for controlling: power on/off, song selection, playing speed and volume, instrument selection and special sound effects, sound sampling, combinations of the same or the like. In operation, user **430** would wave the wand **100** in accordance with one or more specific learned motions selected by the user to achieve a desired effect (e.g., piano on/off, play next song, speed-up/slow down, change piano sound, combinations of the same or the like). Most preferably, the wand **100** contains internal activation circuitry, such as described herein, such that the wand may be activated by the motion induced thereon by a user and so that actuation and control of the special effect appears to be, and has the feeling to user **430** of being, created by "real" magic.

FIG. **29** illustrates another preferred embodiment of a wand-actuated play effect comprising magical or "enchanted" bookshelves **436**. The bookshelves contain multiple shelves of simulated or real books **438** that are controlled by one or more concealed actuators. The actuators are preferably positioned and arranged such that, when actuated, they cause one or more selected books to move, vibrate or levitate. Again, those skilled in the art will readily appreciate that an RF receiver and/or associated controller, such as disclosed and described herein, can easily be concealed within the bookshelves **436** and/or in the vicinity thereof. Movement and vibration of selected books can be provided, for example, by various linear stepper-motor actuators associated with one or more of the books **438**. Each actuator may be controlled, for example, by a magnetic reed switch closure hidden behind the binder of each book. As a user **430** lightly touches the binder of each book with a magnetically-tipped wand **100** the associated reed switch (not shown) is closed, connecting power to an associated vibrator/actuator. Then, as the user **430** waves the wand **100** in one or more particular ways the selected book appears to vibrate or move as if it is being lifted or controlled by the magic wand **100**. More spectacular effects may include, for example: (i) an effect that causes all or some of the books **438** to vibrate or move violently, randomly and/or in a rhythmic pattern (e.g., as if dancing); (ii) an effect that causes one or more books to appear as if floating or levitating; (iii) an effect that causes all or some of the books to magically rearrange themselves; (iv) an effect that causes one or more selected books to talk or tell stories; and (v) an effect that causes two or more books to appear to have a quarrel, argument or debate (e.g., about an interesting historical fact or event). Some or all of these larger, more spectacular effects may be, and preferably are, restricted to only users **430** who possess and have learned to use, for example, a Level-3 wand or above. Thus, for example, a goal-oriented or object-driven, interactive game may be provided wherein play participants compete with one another to learn and master certain game tasks in order to achieve successively more challenging goals or objectives and to thereby earn additional powers, spells, abilities, points, special recognition and/or other rewards within the context of an overall game experience. Preferably, in each case and regardless of the level of wand used, actuation and control of the special effect appears to be, and has the feeling to user **430** of being, created by "real" magic. Of course, many other possible fun and/or exciting special effects will be readily apparent and obvious from the disclosure herein to persons skilled in the art.

FIG. **30** illustrates another preferred embodiment of a wand-actuated play effect comprising a water fountain **440** having one or more associated water features **442** responsive to or controlled by an RF command signal transmitted by one or more wands **100**. An RF receiver and associated controller, such as disclosed and described herein, can easily be placed within an associated fountain control system or panel, electronically interfacing therewith to direct or control various selected fountain features or functions. These may include, for example, on/off control of water flow, fountain lighting, special water features **442**, combinations of the same or the like. In operation, one or more users **430** would wave their wands **100** in accordance with one or more specific learned motions selected by each user to achieve a desired effect (e.g., fountain on, next water feature, increase/decrease water feature, change lighting intensity/color, or the like). Most preferably, each wand **100** contains internal activation circuitry, such as described herein, such that each wand may be activated by the motion induced thereon by each user and so that actuation and control of the special effect appears to be, and has the feeling to users **430** of being, created by "real" magic.

FIGS. **31**A and **31**B are time-lapsed schematic illustrations of a preferred embodiment of a play facility or play center constructed in accordance with the present invention. The play facility may comprise a family entertainment center, retail entertainment space, arcade, theme park, destination resort, restaurant, or the like, themed as a magic training center or any variety of other suitable themes as may be desired. The play facility preferably comprises multiple wand-actuated play effects **400**, such as talking animals **452**, magic hats **454**, crystal balls **456**, enchanted books **458**, and various shooting-gallery-style pop-up target effects **460**, **462**. These may be physical play objects configured with special effects, as illustrated, and/or they may be graphical or computer-generated images displayed, for example, on one or more associated computer monitors, TV monitors, DVD display monitors, or computer gaming consoles and the like, such as illustrated in FIG. **27**B. Those skilled in the art will readily appreciate from the disclosure herein that all of these effects and many other possible play effects may be actuated or controlled by wand **100** using one or more RF receivers, RFID reader/writers and/or magnetic reed switches, as disclosed and described above.

Some interactive play effects **400** may have simple or immediate consequences, while others may have complex and/or delayed consequences and/or possible interactions with other effects. Some play effects **400** may be local (short range) while other effects may be remote (long range). Each play participant **430**, or sometimes a group of play participants working together, preferably must experiment with the various play effects using their magic wands **100** in order to discover and learn how to create one or more desired effect(s). Once one play participant figures it out, he or she can use the resulting play effect to surprise and entertain other play participants. Yet other play participants will observe the activity and will attempt to also figure it out in order to turn the tables on the next group. Repeated play on a particular play element can increase the participants' skills in accurately using the wand **100** to produce desired effects or increasing the size or range of such effects.

Most preferably, a live-action object-oriented or goal-oriented, interactive game is provided whereby play participants compete with one another (and/or against themselves) within a compatible play space to learn and master certain play effects and game tasks in order to achieve successively more challenging goals or game objectives and to thereby earn additional powers, spells, abilities, points, special recognition and/or other rewards within the context of an overall game experience. For example, play participants can compete with one another to see which participant or group of participants can create bigger, longer, more accurate or more spectacular effects. Other goals and game objectives may be weaved into an entertaining story, such as a magical quest or treasure hunt in which play participants immersed. The first task may be to build a magic wand. The next task may be to learn to use the magic wand to locate and open a secret treasure box filled with magical secrets (e.g., various spell formulas or magical powers). The ultimate goal may be to find and transform a particular frog (identified by, e.g., secret markings or other secret characteristics) into a prince/princess. Of course, many other gaming and theming possibilities are possible and desirable. Optionally, various "take home" play effects can also be provided for the purpose of allowing play participants to continue the magical experience (and practice their skills) at home.

In one preferred embodiment, a user **430** would preferably point and/or wave the wand **100** in accordance with one or more specific learned motions or "spells" selected to achieve a desired effect on one or more selected objects. For example, as illustrated in FIG. **31**B, one spell may cause rabbit **452** to talk; another spell may cause hat **454** to magically sprout flowers **464**; another spell may cause book **458** to open with a frog **466** jumping out; another spell may cause an image of a wizard **468** to magically appear (with optional sound and lighting effects) within crystal ball **456**; another spell may cause candle **462** to magically light itself with a pop-up flame **470**. Most preferably, wand **100** contains internal activation circuitry, such as described herein, such that the wand may be activated by the motion induced thereon by user **430** and so that actuation and control of the special effect appears to be, and has the feeling to users **430** of being, created by "real" magic. To provide added mystery and fun, certain effects **400** may be hidden such that they must be discovered by play participants. If desired, various clues can be provided such as, for example, part of a magical mystery game.

In each of the play effects described above, it is possible, and in many cases desirable, to provide additional control interlocks so that multiple input signals are required to actuate a given desired effect. For example, a proximity sensor may be provided associated with a given effect and electronically interlocked with the effect controller such that the effect cannot be operated if the proximity sensor is not also actuated. This could help reduce inadvertent or random actuation of the various effects. Similarly, voice activated controls and voice recognition software could also be implemented and interlocked with the effect controller so that, for example, a user **430** would need to say a particular "magic" word or phrase while waving the magic wand **100** in order to actuate a desired effect.

As mentioned, the proximity sensor may be used to provide a "hover" effect that is indicative of the initialization of a control interlock. For example, when a proximity sensor in the wand **100** is moved within a particular distance of a receiver and/or effects controller, a "hover" effect occurs, such as, for example, the turning on of a light, the movement or vibration of an object, or any other perceptible signal (visual or audible) that notifies the user that a play effect may be initiated. This "hover" effect may notify the user that a spell may be cast so as to cause one or more effects.

In other embodiments, an RFID reader is preferably interlocked with one or more effects controllers in order to provide more precise control of various effects and also improved tracking of game progress, points, or the like. For example, one or more objects or targets **452**, **454**, **456**, **458**, **462** can be selected at close range using an RFID transponder and associated RFID reader. Once all such desired objects have been selected, the long range RF capabilities of the wand **100** can be used to control all of the selected objects/effect simultaneously. Those skilled in the art will readily appreciate from the disclosure herein that similar functionality can be easily provided with various magnetic reed switches and the like provided in association with each object or target. If desired, various pop-up targets **462** and the like may be arranged in a shooting gallery **460** whereby a user **430** can practice aiming the wand **100** and casting various spells at one or more desired targets **462**. In this case the wand **100** preferably is adapted to send directional signals, such as infrared or laser, instead of or in addition to RF signals as described herein.

FIGS. **32**A-D illustrate one preferred embodiment of a wand-actuated game **500** having unique features and benefits in accordance with the present invention. The game **500** basically comprises a 3×7 grid of lighted squares (including optional visual graphics and/or sound effects) that are controlled by a game effects controller (not shown) and one or more RF receivers (not shown). Those skilled in the art will readily appreciate and understand from the disclosure herein how to set up and program a game controller and/or one or more RF receivers as disclosed and described herein so as to achieve the game functionality and various effects as will be described herein below. Preferably, one RF receiver (or IR receiver, RFID receiver, or the like) is provided for each play participant **430** so that command signals from each player can be distinguished. For example, multiple RF receivers may be directionally focused or range-adjusted so as to receive RF command signals only from a selected corresponding player **430***a* or **430***b*.

Individual squares within a defined playing field **504** are preferably lit or dimmed in a timed sequence in response to one or more predetermined RF command signals ("spells") received from one or more RF-enabled wands **100**. Preferably, special 3×1 arrays of squares **510***a*, **510***b* (labeled 1-2-3) are provided at opposite ends of a playing field **504** and are adapted to respond to a signal imposed by, for example, the presence, proximity or weight of play participants **430***a*, **430***b*, as they stand on each square. These special squares may be raised or otherwise differentiated, as desired, to indicate their special function within the game **500**. Actuating individual squares within arrays **510***a* and **510***b* (e.g., by stepping or standing on them) allows play participants **430***a*, **430***b* to select a corresponding column of squares in the playing field **504** in which they may desire to launch an attack, counterattack or defense using various learned spells or incantations. Spells may be actuated, for example, by waving wand **100** in one or more particular learned motions selected to produce a desired play effect or spell. An infinite variety of such spells are possible as described above.

Preferably, when a spell is successfully cast by a player **430***a* or **430***b*, the first square immediately in front of the player lights up or is otherwise controlled to produce a special effect indicating that a spell has been cast. Other squares in the same column are then preferably lit in a timed sequence or progression moving toward the opposing player (see, e.g., FIGS. **32**B and **32**C). Most preferably, the lighting effects for each square and/or other associated special effects are controlled or varied in a way to indicate the type of spell cast (e.g., a fire ball spell, ice spell, transforming spell, or the like). For example, various colors or patterns of lights may be used to indicate each spell. Alternatively, various graphic images and/or associated sound effects may be used to indicate each spell. These may be displayed, for example, on an overhead TV or associated computer monitor (not shown).

When an opposing player perceives that a spell has been cast and is moving toward him, that player (e.g., player **430***b* in FIG. **32**B) attempts to quickly identify the type of spell and to cast in the same column a counter-measure or "blocking spell" in an attempt to neutralize or block the advancing spell (see, e.g., FIG. **32**C). The blocking spell may be cast, for example, using the same particular wand motion or series of wand motions used to cast the "forward spell", except with a "block" command added. Thus, a blocking spell is launched toward the advancing spell, as indicated by a progression of lighted squares and/or other effects controlled in a similar fashion as described above. If the blocking spell is effective (i.e., properly selected and executed), then the advancing spell is neutralized and the lighted column of squares is cleared (see, e.g., FIGS. **32**C and **32**D). If the blocking spell is ineffective, then the advancing spell continues until it reaches the end of the column. Preferably, whenever a spell reaches the opposing side, points and/or other gaming advancements are awarded to the successful player. These may vary, for example, depending upon the difficulty level of the spell, the experience level of the opposing player, and the like. In one particularly preferred embodiment, successful players are rewarded (and unsuccessful players are punished) by allowing certain spells to "capture" or disable the opposing player's special square in each corresponding column (see, e.g., FIG. **32**D). Once all of a player's special squares **510***a*, **510***b* have been captured or disabled the game is ended.

Preferably, the speed of game play progresses and becomes faster and faster as game play continues (e.g., spells move faster). In this manner, the game **500** continually challenges game participants to improve their reaction speed and spell accuracy. The game also encourages players to learn and master more difficult or complex spells, as these will be typically be harder and take longer for an opponent to successfully block. Certain additional spells or advanced commands may also be provided for speeding up a spell or slowing down an advancing spell. Any infinite variety and possibility of other spells and game play nuances are possible and desirable in accordance with the fundamental aspects of the invention disclosed and described herein.

Those skilled in the art will also recognize from the disclosure herein that the game **500** is not limited to use with RF-enabled input devices, such as wands, cards, tokens and the like, as described herein. Alternatively, the game **500** may be readily adapted and used with a wide variety of other input devices, including, without limitation, RFID tracking, magnetic actuators, joysticks, push-buttons, computer mouse or keypad, foot pedals, motion sensors, virtual-reality gloves and the like, proximity sensors, weight sensors, or the like. Similarly, the game **500** is not limited to use with a magic theme, but may be implemented in a wide variety of other suitable themes such as, without limitation, war games, martial arts, "shoot-out" games, alien invasion, memory games, board games, educational games, trivia games, strategy games, and the like. It is also specifically contemplated that the game **500** may be expanded or modified to accommodate 3 or more players. For example, a six-sided game field accommodating up to six different players may easily be implemented using a similar playing field made up of hexagonal "squares".

Master System

In addition, a skilled artisan will recognize from the disclosure herein that the foregoing competitive games and/or play effects may use a central or master system to coordinate, control, and/or monitor the status of the games or effects in a particular area. For example, a central database may be used to monitor the skill levels of all those who are participating in the competitive game in a particular location. In other embodiments, the central system may comprise a centralized computer network that monitors the operation of each wand **100** (e.g., the play effects caused by operation of the wand) within a particular area. In yet other embodiments, the wands **100** may automatically download information from the central system.

If a master system is utilized, preferably each wand **100** and/or RFID card **325** is configured to electronically send and receive information to and from various receivers or transceivers **300** distributed throughout a play environment using a send receive radio frequency ("SRRF") communication protocol. This communications protocol provides the basic foundation for a complex, interactive entertainment system which creates a seemingly magic interactive play experience for play participants who possess and learn to use the magic wand. In its most refined embodiments, a user may electronically send and receive information to and from other wands and/or to and from a master control system located within and/or associated with any of a number of play environments, such as a family entertainment facility, restaurant play structure, television/video/radio programs, computer software program, game console, web site, etc. This newly created network of SRRF-compatible play and entertainment environments provides a complex, interactive play and entertainment system that creates a seamless magical interactive play experience that transcends conventional physical and temporal boundaries.

SRRF may generally be described as an RF-based communications technology and protocol that allows pertinent information and messages to be sent and received to and from two or more SRRF compatible devices or systems. While the specific embodiments described herein are specific to RF-based communication systems, those skilled in the art will readily appreciate that the broader interactive play concepts taught herein may be realized using any number of commercially available 2-way and/or 1-way medium range wireless communication devices and communication protocols such as, without limitation, infrared-, digital-, analog, AM/FM-, laser-, visual-, audio-, and/or ultrasonic-based systems, as desired or expedient.

The SRRF system can preferably send and receive signals (up to 40 feet) between tokens and fixed transceivers. The system is preferably able to associate a token with a particular zone as defined by a token activation area approximately 10-15 feet in diameter. Different transceiver and antenna configurations can be utilized depending on the SRRF requirements for each play station. The SRRF facility tokens and transceivers are networked throughout a play environment. These devices can be hidden in or integrated into the environmental infrastructure, such as walls, floors, ceilings and play station equipment. Therefore, the size and packaging of these transceivers is not particularly critical.

In a preferred embodiment, an entire entertainment facility may be configured with SRRF technology to provide a master control system for an interactive entertainment play environment using SRRF-compatible magic wands and/or tracking devices. A typical entertainment facility provided with SRRF technology may allow 300-400 or more users to more-or-less simultaneously send and receive electronic transmissions to and from the master control system using a magic wand or other SRRF-compatible tracking device.

In particular, the SRRF system uses a software program and data-base that can track the locations and activities of up to a hundred or more users. This information is then used to adjust the play experience for each user based on "knowing" where the user/player has been, what objectives that player has accomplished and how many points or levels have been reached. The system can then send messages to the user throughout the play experience. For example, the system can allow or deny access to a user into a new play area based on how many points or levels have been reached by that user and/or based on what objectives that user has accomplished or helped accomplish. It can also indicate, via sending a message to the user the amount of points or specific play objectives necessary to complete a "mission" or enter the next level of play. The master control system can also send messages to the user from other users.

The system is preferably sophisticated enough that it can allow multiple users to interact with each other adjusting the game instantly. The master system can also preferably interface with digital imaging and/or video capture so that the users activities can be visually tracked. Any user can locate another user either through the video capturing system or by sending a message to another device. At the end of a visit, users are informed of their activities and the system interfaces with printout capabilities. The SRRF system is preferably capable of sending and receiving signals up to 100 feet. Transmitter devices can also be hidden in walls or other structures in order to provide additional interactivity and excitement for play participants.

Suitable embodiments of the SRRF technology described above may be obtained from a number of suitable sources, such as AXCESS, Inc. and, in particular, the AXCESS active RFID network system for asset and people tacking applications. In another preferred embodiment the system comprises a network of transceivers **300** installed at specific points throughout a facility. Players are outfitted or provided with a reusable "token"-a standard AXCESS personnel tag clipped to their clothing in the upper chest area. As each player enters a specific interactive play area or "game zone" within the facility, the player's token receives a low frequency activation signal containing a zone identification number (ZID). The token then responds to this signal by transmitting both its unique token identification number (TID) along with the ZID, thus identifying and associating the player with a particular zone.

The token's transmitted signal is received by a transceiver **300** attached to a data network built into the facility. Using the data network, the transceiver forwards the TID/ZID data to a host computer system. The host system uses the SRRF information to log/track the guest's progress through the facility while interfacing with other interactive systems within the venue. For example, upon receipt of a TID/ZID message received from Zone **1**, the host system may trigger a digital camera focused on that area, thus capturing a digital image of the player which can now be associated with both their TID and the ZID at a specific time. In this manner the SRRF technology allows the master control system to uniquely identify and track people as they interact with various games and activities in a semi-controlled play environment. Optionally, the system may be configured for two-way messaging to enable more complex interactive gaming concepts.

In another embodiment, the SRRF technology can be used in the home. For enabling magic at the home, a small SRRF module is preferably incorporated into one or more portable toys or objects that may be as small as a beeper. The SRRF module supports two-way communications with a small home transceiver, as well as with other SRRF objects. For example, a magic wand **100** can communicate with another magic wand **100**.

The toy or object may also include the ability to produce light, vibration or other sound effects based on signals received through the SRRF module to complement the operation of the wand and/or the effects achieved. In a more advanced implementation, the magical object may be configured such that it is able to display preprogrammed messages of up to 50 characters or more on a LCD screen when triggered by user action (e.g. button) or via signals received through the SRRF module. This device is also preferably capable of displaying short text messages transmitted over the SRRF wireless link from another SRRF-compatible device. For example, FIG. **19**G shows a toy wand **100** having an LCD screen **113** for displaying short text messages.

Preferably, the SRRF transceiver **300** is capable of supporting medium-to-long range (10-40 feet) two-way communications between SRRF objects and a host system, such as a PC running SRRF-compatible software. This transceiver **300** has an integral antenna and interfaces to the host computer through a dedicated communication port using industry standard RS232 serial communications. It is also desirable that the SRRF transmission method be flexible such that it can be embedded in television or radio signals, videotapes, DVDs, video games and other programs media, stripped out and re-transmitted using low cost components. The exact method for transposing these signals, as well as the explicit interface between the home transceiver and common consumer electronics (i.e. TVs, radios, VCRs, DVD players, A/V receivers, etc.) is not particularly important, so long as the basic functionality as described above is achieved. The various components needed to assemble such an SRRF system suitable for use with the present invention are commercially available and their assembly to achieve the desired functionality described above can be readily determined by persons of ordinary skill in the art. If desired, each SRRF transceiver may also incorporate a global positioning ("GPS") device to track the exact location of each play participant within one or more play environments.

Most desirably, a SRRF module can be provided in "chip" form to be incorporated with other electronics, or designed as a packaged module suitable for the consumer market. If desired, the antenna can be embedded in the module, or integrated into the toy and attached to the module. Different modules and antennas may be required depending on the function, intelligence and interfaces required for different devices. A consumer grade rechargeable or user replaceable battery may also be used to power both the SRRF module and associated toy electronics.

Interactive Game Play

Embodiments of the present invention may be carried out using a wide variety of suitable game play environments, storylines and characters, as will be readily apparent to those skilled in the art. The following specific game play examples are provided for purposes of illustration and for better understanding of the invention and should not be taken as limiting the invention in any way:

EXAMPLE 1

An overall interactive gaming experience and entertainment system is provided (called the "Magic" experience), which tells a fantastic story that engages children and families in a never-ending adventure based on a mysterious treasure box filled with magical objects. Through a number of entertainment venues such as entertainment facilities, computer games, television, publications, web sites, and the like, children learn about and/or are trained to use these magical objects to become powerful "wizards" within one or more defined "Magic" play environments. The play environments may be physically represented, such as via an actual existing play structure or family entertainment center, and/or it may be visually/aurally represented via computer animation, television radio and/or other entertainment venue or source.

The magical objects use the SRRF communications system allowing for messages and information to be received and sent to and from any other object or system. Optionally, these may be programmed and linked to the master SRRF system. Most preferably, the "magic wand" **100** is configured to receive messages from any computer software, game console, web site, and entertainment facility, television program that carries the SRRF system. In addition, the magic wand can also preferably send messages to any SRRF compatible system thus allowing for the "wand" to be tracked and used within each play environment where the wand is presented. The toy or wand **100** also preferably enables the user to interact with either a Master system located within a Magic entertainment facility and/or a home-based system using common consumer electronic devices such as a personal computer, VCR or video game system.

The master control system for a Magic entertainment facility generally comprises: (1) a "token" (gag, toy, wand **100** or other device) carried by the user **430**, (2) a plurality of receivers or transceivers **300** installed throughout the facility, (3) a standard LAN communications system (optional), and (4) a master computer system interfaced to the transceiver network (optional). If a Master computer system is used, preferably the software program running on the Master computer is capable of tracking the total experience for hundreds of users substantially in real time. The information is used to adjust the play for each user based on knowing the age of the user, where the user has played or is playing, points accumulated, levels reached and specific objectives accomplished. Based on real-time information obtained from the network, the system can also send messages to the user as they interact throughout the Magic experience.

The Master system can quickly authorize user access to a new play station area or "zone" based on points or levels reached. It can also preferably indicate, via sending a message to the user, the points needed or play activities necessary to complete a "mission." The Master system can also send messages to the user from other users. The system is preferably sophisticated enough to allow multiple users to interact with each other while enjoying the game in real-time.

Optionally, the Master system can interface with digital imaging and video capture so that the users' activities can be visually tracked. Any user can then locate another user either through the video capturing system or by sending a message to another device. At the end of a visit, users are informed of their activities and other attributes related to the Magic experience via display or printout.

For relatively simple interactive games, the Master system may be omitted in order to save costs. In that case, any game-related information required to be shared with other receivers or transceivers may be communicated via an RS-232 hub network, Ethernet, or wireless network, or such information may be stored on the wand itself and/or an associated RFID card or badge carried by the play participant. For retrofit applications, it is strongly preferred to provide substantially all stand-alone receivers or transceivers that do not communicate to a master system or network. This is to avoid the expense of re-wiring existing infrastructure. For these applications, any information required to be shared by the game system is preferably stored on the wand or other RFID device(s) carried by the play participants. Alternatively, if a more complex game experience is demanded, any number of commercially available wireless networks may be provided without requiring rewiring of existing infrastructure.

EXAMPLE 2

A computer adventure game is provided in which one or more play participants assume the role of an imaginary character "Pajama Sam" from the popular series of computer games published by Humongous Entertainment, Inc. of Woodinville, Wash. A Pajama Sam adventure character card **700**, such as illustrated in FIGS. **34**A, **34**B, is provided to each play participant. The card may be packaged and sold together with the game software, and/or it may be sold separately, as convenience and market demands dictate.

The card **700** may be constructed substantially the same as the cards **325**, **600** illustrated and described above in connection with FIGS. **20**C-D and **33**, except with different character illustrations and/or graphics. For example, each card **700** may include a different character from the Pajama Sam computer game series representing a role-play character desired to be imagined by a play participant. The obverse side (FIG. **34**B) includes an RFID tag **720**, such as illustrated and described above in connection with FIG. **20**D. Preferably, the tag **720** is covered with an adhesive paper label **725**. Alternatively, the tag **720** may be molded directly into a plastic sheet substrate from which the card **700** is then formed. Alternatively, a magnetic "swipe" strip and/or other well-known information storage means may be used with efficacy, so long as it is relatively compact, durable and inexpensive.

The particular size, shape and theme of the card **700** is relatively unimportant. In the particular embodiment illustrated, the card **700** is shaped and themed similar to a baseball trading card so that they may be collected and stored conveniently in any baseball card album or the like. If desired, a hole or eyelet (not shown) may be provided at the top of the card **700** so as to facilitate wearing the card **700** as a pendant on a necklace or as key-chain trinket. Of course, smaller, pocket-sized cards and/or other similar RFID or magnetic transponder devices may also be used where convenience and market demand dictates. Such alternative suitable transponder devices are commercially available, such as from Texas Instruments, Inc. (http://www.tiris.com, e.g., Prod. Nos. RI-TRP-W9WK, RI-TRP-R9QL, RI-TRP-WFOB).

A specially configured computer, video game, home game console, hand-held gaming device or similar gaming device is provided with a reader, and more preferably a reader/writer such as described above, that is able to communicate with the tag **720** or other information storage means associated with the card **700**. As each play participant plays his or her favorite Pajama Sam game the Pajama Sam character represented by the card **700** gains (or loses) certain attributes, such as speed, dexterity, and/or the possession of certain tools or objects associated with the game play. All of this information is preferably stored on the card **700** so that the character attributes may be easily and conveniently transported to other similarly-equipped computer games, video games, home game consoles, hand-held game units, play facilities, and the like. In this manner, an imaginary role-play character is created and stored on a card that is able to seamlessly transcend from one play medium to the next.

For example, in the course of playing a typical Pajama Sam game, players must "find" certain objects or tools that they will use to solve certain puzzles or tasks presented by the game. Players "pick up" these objects or tools by clicking their mouse on the desired object. The computer game software then keeps a record of which objects have been collected and displays those objects on the computer screen when requested by the player. This is illustrated by FIG. **35**A, which is a screen shot from the computer game, "Pajama Sam, in No Need to Hide When It's Dark Outside," published by Humongous Entertainment, Inc. © 1996. The game begins in Pajama Sam's bedroom, and the player is asked to find and click on certain objects **810** that Pajama Sam needs to begin his adventure—namely his flashlight, PajamaMan lunch box and PajamaMan mask. As these objects are located and collected, they are displayed on the bottom of the computer screen, as illustrated in FIG. **35**A.

FIG. **35**B is a screen shot from the same game where the player faces his first challenge or puzzle to solve. He or she must somehow make Pajama Sam operate the elevator **815** to take Pajama Sam up into the tree house **820** where his arch-enemy "Darkness" resides. To solve the puzzle the player explores the scene with his mouse and clicks on objects that might be useful to solve the puzzle. Eventually, the player will discover a pile of rocks **825** which Pajama Sam picks up and tosses into the basket **830** to operate the elevator. In the next scene (FIG. **35**E) Pajama Sam is inside the tree house and the player must decide which of three possible paths to take representing doors **840**, **845** and **850**. Doorway **850** leads to the scene illustrated in FIG. **35**D in which Pajama Sam (and the player) is challenged to a trivia game by a pair of talking doors. The player chooses from different categories of questions and attempts to choose correct answers from a multiple choice list provided by the game (see FIG. **35**E). Ultimately, the player is challenged with a question specific to the game (see FIG. **35**F) and which requires the player to have visited a particular location within the game where the information is contained. If the player has not completed that portion of the computer game, he or she cannot answer the question posed and Pajama Sam cannot advance in the adventure game (see FIG. **35**G).

If the player were to quit the game at this point, he or she could save the game on the host computer and return to the same computer later to complete the adventure. But the Pajama Sam character itself, its attributes, experiences and accomplishments are not portable and cannot presently be transferred from one game or gaming environment to another. However, the Pajama Sam adventure card **700** in accordance with the present invention enables a play participant to continue the adventure somewhere else (e.g. at a friend's house, or a video arcade facility) without having to restart the game and repeat the steps that the player has already accomplished. With the Pajama Sam adventure card **700**, relevant details of the game experience and the Pajama Sam character are stored on the card **700** so that the player can take the card to another computer, game console, hand-held game device or a designated Pajama Sam play facility, to continue the adventure in a new and exciting play environment.

For example, the Pajama Sam play facility could be configured as a physical play space having theming and game play that parallels that of one or more of the Pajama Same computer adventure games. Now our computer game player who has a Pajama Sam adventure card **700** can visit this play facility and the facility would be able to read the information on the card and determine that this particular player has already completed the first puzzle in the first Pajama Sam computer adventure game. If the player desires, he or she will be allowed to advance automatically in the game play within the Pajama Sam play facility so that the player can work on a new puzzle. If the player successfully solves a new puzzle at the play facility, this information will be recorded on the Pajama Sam adventure card **700**. The next time he or she plays the computer game the card can be automatically read and the computer experience can be modified or updated in accordance with the new information recorded on the card. In this manner, the character role-play experience becomes portable, personal and long-term. This, in turn, facilitates the development of even more sophisticated and complex role-play characters and longer, more enjoyable role play experiences as players are able to continue playing with and developing the same role-play character(s) over long periods of time and in different and varied play environments.

Similarly, various other video games, home game consoles, and/or hand-held game units can be and preferably are configured to communicate with the Pajama Sam adventure card **700** in a similar manner as described above and/or using other well-known information storage and communication techniques. In this manner, a play participant can use the Pajama Sam adventure card **700** and the role play character he or she has developed with specific associated attributes in a favorite video action game, role-play computer game, internet adventure game or the like.

EXAMPLE 3

A trading card game is provided wherein a plurality of cards depicting various real or imaginary persons, characters and/or objects are provided and wherein each card has recorded or stored thereon in an electronically readable format certain selected information pertaining to the particular person, character or object, such as performance statistics, traits/powers, or special abilities. The information is preferably stored on an RFID tracking tag associated with each card and which can be read electronically and wirelessly over a predetermined range preferably greater than about 1 cm when placed in the proximity of a suitably configured RF reader. Optionally, the RFID tag may be read/write capable such that it the information stored thereon may be changed or updated in any manner desired. Alternatively, a magnetic strip, bar code or similar information storage means may be used to store relevant information on the card.

FIGS. **36**A and **36**B depict one preferred embodiment of a trading card **900** having features and advantages in accordance with the present invention. The particular trading card illustrated in FIG. **36**A is provided in the theme of the popular Pokemon characters and, in particular, the character Pikachu. FIGS. **36**C and **36**D illustrate several other possible Pokemon themed trading cards which may be provided in accordance with the present invention. Each card preferably comprises a paper, cardboard or plastic substrate having a front side **905** and a back side **910**. The front **905** of the card **900** may be imprinted with graphics, photos, or any other information as desired. In the particular embodiment illustrated, the front **905** contains an image of the Pikachu character **925** in keeping with the Pokemon theme. In addition, the front **905** of the card **900** may include any number of other designs or information **930** pertinent to its application. For example, the character's type, size and evolution may be indicated, along with any special powers or traits the character may possess.

The obverse side **910** of the card **900** preferably contains the card electronics comprising a radio frequency tag **920** pre-programmed with the pertinent information for the particular person, character or object portrayed on the front of the card. The tag **920** generally comprises a spiral wound antenna **950**, a radio frequency transmitter chip **960** and various electrical leads and terminals **970** connecting the chip **960** to the antenna. If desired, the tag **920** may be covered with an adhesive paper label (not shown) or, alternatively, the tag may be molded directly into a plastic sheet substrate from which the card **900** is formed.

Preferably, the tag **920** is passive (requires no batteries) so that it is inexpensive to purchase and maintain. Such tags and various associated readers and other accessories are commercially available in a wide variety of configurations, sizes and read ranges. RFID tags having a read range of between about 10 cm to about 100 cm are particularly preferred, although shorter or longer read ranges may also be acceptable. The particular tag illustrated is the 13.56 MHz tag sold under the brand name Tag-it™ available from Texas Instruments, Inc. (http://www.tiris.com, Product No. RI-I03-110A). The tag **920** has a useful read/write range of about 25 cm and contains 256-bits of on-board memory arranged in 8×32-bit blocks which may be programmed (written) and read by a suitably configured read/write device. If a longer read/write range and/or more memory is desired, optional battery-powered tags may be used instead, such as available from AXCESS, Inc. and/or various other vendors known to those skilled in the art.

Cards **900** may be collected or traded and/or they may be used to play various games, such as a Pokemon arena competition using an electronic interface capable of reading the card information. Such games may be carried out using a specially configured gaming device or, alternatively, using a conventional computer gaming platform, home game console, arcade game console, hand-held game device, internet gaming device or other gaming device that has been modified to include an RF reader or magnetic "swipe" reader device as illustrated and described above. Advantageously, play participants can use the trading cards **900** to transport information pertinent to a particular depicted person, character or object to a favorite computer action game, adventure game, interactive play structure or the like. For example, a suitably configured video game console and video game may be provided which reads the card information and recreates the appearance and/or traits of particular depicted person, character of object within the game. If desired, the game console may further be configured to write information to the card in order to change or update certain characteristics or traits of the character, person or object depicted by the card **900** in accordance with a predetermined game play progression.

Of course, those skilled in the art will readily appreciate that the underlying concept of an RFID trading card **900** and card game is not limited to cards depicting fantasy characters or objects, but may be implemented in a wide variety of alternative embodiments, including sporting cards, baseball, football and hockey cards, movie character cards, dinosaur cards, educational cards and the like. If desired, any number of other suitable collectible/tradable tokens or trinkets may also be provided with a similar RFID tag device in accordance with the teachings of the present invention as dictated by consumer tastes and market demand.

Although this invention has been disclosed in the context of certain preferred embodiments and examples, it will be understood by those skilled in the art that the present invention extends beyond the specifically disclosed embodiments to other alternative embodiments and/or uses of the invention and obvious modifications and equivalents thereof. Thus, it is intended that the scope of the present invention herein disclosed should not be limited by the particular disclosed embodiments described above, but should be determined only by a fair reading of the claims that follow.

What is claimed is:

1. A portable handheld device for gaming or entertainment comprising dual transceivers for providing both short- and medium-range wireless communications with one or more wireless-compatible devices, said portable handheld device comprising:

a body comprising an internal cavity configured to hold one or more internal power sources and associated circuitry configured to power and operate said portable handheld device;

an input interface configured to receive one or more user inputs;

a display screen configured to display information;

non-volatile memory configured to store at least one unique identifier uniquely identifying said portable handheld device;

a first radio frequency (RF) transceiver configured to provide medium-range two-way wireless communication with a medium-range wireless-compatible device over a first wireless communication range of at least 10 feet; and

a second RF transceiver configured to provide short-range two-way wireless communication with a short-range wireless-compatible device over a second wireless communication range of less than 25 cm and wherein said short-range communication is facilitated at least in part through inductive coupling;

wherein said second RF transceiver is further configured such that when a user selectively causes said second RF transceiver to come within a wireless communication range of a short-range wireless-compatible gaming or entertainment device, said second RF transceiver wirelessly transmits selected information to said short-range wireless-compatible gaming or entertainment device, including at least said at least one unique identifier.

2. The portable handheld device of claim **1**, wherein said medium-range wireless-compatible device comprises a wireless-compatible gaming platform configured to produce a computer-generated play environment on an associated display device and wherein said portable handheld device is configured to operate with said wireless-compatible gaming platform as a wireless input controller for enabling a game participant to selectively activate or control one or more visual, aural or tactile effects in accordance with a game.

3. The portable handheld device of claim **2**, further comprising a game effects generator configured to produce at least one game-relevant sound, vibration or lighting effect based on information wirelessly communicated to said portable handheld device by said wireless-compatible gaming platform.

4. The portable handheld device of claim **2**, in combination with a wireless-compatible gaming platform comprising one or more of: a video game console, a home game console, a portable game unit, a personal computer, or a live-action play facility.

5. The combination of claim **4**, in further combination with an image capture system configured to capture one or more digital images of the game participant playing the game using said portable handheld device.

6. The portable handheld device of claim **1** in combination with a short-range wireless-compatible gaming or entertainment device.

7. The combination of claim **6**, wherein said short-range wireless-compatible gaming or entertainment device comprises one or more of: a television, a radio, a video recorder, or a DVD player.

8. The combination of claim **6**, wherein said short-range wireless-compatible gaming or entertainment device comprises a second portable handheld device configured in accordance with claim **1**.

9. The combination of claim **6**, wherein said short-range wireless-compatible gaming or entertainment device comprises an RFID-tagged physical game card, token or trinket depicting or representing a person, character or object relevant to a game.

10. The portable handheld device of claim **1**, wherein said body is further configured to be held freely in the air and operated at least in part by moving the entire said body in one or more motions, and wherein said input interface comprises one or more sensors configured to sense said one or more motions.

11. The portable handheld device of claim **1**, wherein said input interface comprises a button or switch selectively operable by a user.

12. The portable handheld device of claim **1**, further comprising at least one antenna configured to be energized through inductive coupling with an external electromagnetic field to thereby wirelessly power at least said second RF transceiver.

13. The portable handheld device of claim **1**, further comprising at least one antenna configured to generate an external electromagnetic field to wirelessly power said short-range wireless-compatible device through inductive coupling.

14. The portable handheld device of claim **1**, wherein said second RF transceiver comprises a reader device configured to wirelessly power and exchange one or more wireless communications with said short-range wireless-compatible device.

15. The portable handheld device of claim **1**, further comprising a global positioning system (GPS) device configured to determine a location of said portable handheld device.

16. An interactive entertainment system for entertaining one or more game participants playing a computer-animated game displayed on an associated display device, said interactive entertainment system comprising:

at least one game console comprising:

a computing device configured to produce one or more computer-animated effects in accordance with a game; and

a first wireless transceiver configured to provide two-way wireless communications with one or more wireless-compatible devices over a wireless communication range of at least 10 feet;

at least one wireless-compatible device comprising a portable wireless controller configured to control or direct said game, said wireless controller comprising:

a body comprising an internal cavity configured to hold one or more internal power sources and associated circuitry configured to power and operate said wireless controller, said body configured to be held and moved freely in the air and to be operated by a game participant at least in part by moving the entire said body of said wireless controller;

at least one sensor arranged within said body so as to sense motions of said body in free space;

non-volatile memory configured to store at least one unique identifier uniquely identifying said wireless controller;

a second wireless transceiver configured to provide two-way wireless communications with at least said first wireless transceiver over said wireless communication range of at least 10 feet; and

at least one lighting effect configured to illuminate based on one or more wireless communications communicated from said first wireless transceiver to said second wireless transceiver; and

an image capture system configured to automatically capture one or more digital images of said game participant playing said game.

17. The interactive entertainment system of claim **16**, wherein said at least one game console is configured to connect to a network of other game consoles and to receive through said network selected game-relevant information comprising game progress or performance of other game participants playing said game on said other game consoles.

18. The interactive entertainment system of claim **16**, wherein said first and second wireless transceivers comprise radio frequency (RF) transceivers.

19. The interactive entertainment system of claim **16**, wherein said wireless controller further comprises a display screen configured to display selected messages or other game-relevant information based on one or more wireless communications received by said second wireless transceiver.

20. The interactive entertainment system of claim **16**, wherein said wireless controller further comprises a sound- or vibration-effects generator configured to produce one or more vibration or sound effects based on one or more wireless communications received by said second wireless transceiver.

21. The interactive entertainment system of claim **16**, wherein said wireless controller further comprises a global positioning system (GPS) device configured to determine a location of said wireless controller.

22. The interactive entertainment system of claim **16**, wherein said wireless controller further comprises at least one function button configured to be selectively actuated by the game participant to activate or enable one or more desired functions.

23. The interactive entertainment system of claim **16**, wherein said wireless controller further comprises a third wireless transceiver configured to provide two-way wireless communication with a wireless-compatible device over a limited wireless communication range of less than 25 cm, and wherein said limited-range communication is facilitated at least in part through inductive coupling.

24. The interactive entertainment system of claim **23**, wherein said wireless controller and said third wireless transceiver are further configured such that when a game participant selectively moves said body of said wireless controller and thereby causes said third wireless transceiver to come within said limited wireless communication range of a limited-range wireless-compatible device, said third wireless transceiver wirelessly transmits selected information to said limited-range wireless-compatible device, including said at least one unique identifier.

25. The interactive entertainment system of claim **24**, wherein said wireless controller further comprises at least one antenna configured to be energized through inductive coupling with an external electromagnetic field to thereby wirelessly power at least said third wireless transceiver.

26. The interactive entertainment system of claim **24**, wherein said wireless controller further comprises at least one antenna configured to generate an external electromagnetic

field to wirelessly power said limited-range wireless-compatible device through inductive coupling.

27. The interactive entertainment system of claim **16**, further comprising game software configured to be executed by said at least one game console to carry out said game, said game software comprising program instructions for instructing said game console to: i) conduct an interactive game in which a virtual play environment is represented through one or more computer animations, ii) track the game progress or performance of one or more game participants playing said game, and iii) adjust a play experience for each game participant based at least in part on said tracked game progress or performance.

28. A portable wireless game controller for controlling or directing a computer-animated game displayed on an associated display device, said portable wireless game controller comprising:

a body comprising an internal cavity configured to hold one or more internal power sources and associated circuitry configured to power and operate said portable wireless game controller, said body configured to be held and moved freely in the air and to be operated by a game participant at least in part by moving the entire said body of said portable wireless game controller;

at least one sensor arranged within said body so as to sense one or more motions or positions of said body in free space;

non-volatile memory configured to store at least one unique identifier uniquely identifying said portable wireless game controller;

a first radio frequency (RF) transceiver configured to provide two-way wireless communications with a wireless-compatible gaming platform over a wireless communication range of at least 10 feet; and

an effects controller configured to produce at least one lighting effect, at least one sound effect, and at least one vibration effect in accordance with said game and based at least in part on one or more wireless communications received by said first RF transceiver.

29. The portable wireless game controller of claim **28**, wherein said body comprises an elongated body extending along an axis of elongation from a first end configured to be held or gripped by a single hand of said game participant to a second end extending coaxially from said first end.

30. The portable wireless game controller of claim **28**, wherein said at least one sensor is arranged relative to said body so as to sense one or more waving, twisting or shaking motions of said body.

31. The portable wireless game controller of claim **30**, wherein said at least one sensor is configured to sense and distinguish said one or more waving, twisting or shaking motions.

32. The portable wireless game controller of claim **28**, further comprising a display screen configured to display selected messages or other game-relevant information based on one or more wireless communications received by said first RF transceiver.

33. The portable wireless game controller of claim **28**, further comprising at least one function button configured to be selectively actuated by said game participant to selectively activate one or more associated functions.

34. The portable wireless game controller of claim **28**, further comprising a second RF transceiver configured to provide short-range two-way wireless communication with a short-range wireless-compatible device over a limited wireless communication range of less than 25 cm, and wherein said short-range communication is facilitated at least in part through inductive coupling.

35. The portable wireless game controller of claim **34**, wherein said second RF transceiver is configured such that when said game participant selectively causes said portable wireless game controller to come within said limited wireless communication range of said short-range wireless-compatible device, said second RF transceiver wirelessly transmits selected information to said short-range wireless-compatible device, including at least said at least one unique identifier.

36. The portable wireless game controller of claim **35**, further comprising at least one antenna configured to be energized through inductive coupling with an external electromagnetic field to thereby wirelessly power said second wireless transceiver when said portable wireless game controller touches or comes within the limited wireless communication range of the short-range wireless-compatible device.

37. The portable wireless game controller of claim **35**, further comprising at least one antenna configured to generate an external electromagnetic field to wirelessly power said short-range wireless-compatible device through inductive coupling when said portable wireless game controller touches or comes within the limited wireless communication range of the short-range wireless-compatible device.

38. The portable wireless game controller of claim **37**, in combination with a short-range wireless-compatible device comprising one or more RFID-tagged gaming items depicting or representing one or more of persons, characters or objects relevant to said game.

39. The portable wireless game controller of claim **28**, in combination with a wireless-compatible gaming platform comprising one or more of: a video game console, a home game console, a portable game unit, a personal computer, or a live-action play facility.

40. The combination of claim **39**, in further combination with an image capture system configured to capture one or more digital images of said game participant playing said game while using said portable wireless game controller.

41. A method for entertaining one or more game participants playing an interactive game, said method comprising:

producing, via at least one wireless-compatible gaming platform, one or more computer-animated, effects in accordance with an interactive game, said at least one wireless-compatible gaming platform comprising a first wireless transceiver configured to provide two-way wireless communications with one or more wireless-compatible devices;

wirelessly communicating, via at least one portable wireless gaming device, selected game-relevant information configured to enable a game participant to wirelessly interact with said interactive game, said portable wireless gaming device comprising:

a body configured to be held and moved freely in the air;

at least one sensor configured to sense motions of said body in free space and to generate sensor state data based thereon;

non-volatile memory configured to store at least one unique identifier uniquely identifying said portable wireless gaming device; and

a second wireless transceiver configured to provide two-way wireless communications with at least said first wireless transceiver;

causing said first and second wireless transceivers to exchange one or more wireless communications and wherein said one or more wireless communications include communication of said at least one unique identifier and said sensor state data; and

automatically capturing one or more digital images of said game participant while said game participant is playing said interactive game.

42. The method of claim **41**, wherein said at least one wireless-compatible gaming platform comprises one or more of: a video game console, a home game console, a portable game unit, a personal computer, or a live-action play facility.

43. The method of claim **42**, further comprising configuring said at least one wireless-compatible gaming platform to: i) connect to a network of other wireless-compatible gaming platforms, and ii) receive through said network selected game-relevant information pertaining to other game participants playing said game using said other wireless-compatible gaming platforms.

44. The method of claim **41**, further comprising wirelessly powering said second wireless transceiver through inductive coupling when said portable wireless gaming device is placed in an external electromagnetic field.

45. The method of claim **41**, further comprising causing said portable wireless gaming device to generate an external electromagnetic field having sufficient energy to wirelessly power one or more wireless-compatible devices through inductive coupling.

46. The method of claim **41**, wherein said first and second wireless transceivers comprise radio frequency (RF) transceivers configured to provide medium-range two-way wireless communications over a wireless communication range of at least 10 feet.

47. The method of claim **46**, wherein said at least one gaming platform or said at least one portable wireless gaming device further comprises a third wireless transceiver configured to provide short-range two-way wireless communications with a short-range wireless-compatible device over a limited wireless communication range of less than 25 cm, and wherein said short-range communication is facilitated at least in part through inductive coupling, and further comprising causing said third wireless transceiver to transmit selected information by selectively placing said short-range wireless-compatible device within said limited wireless communication range of said third wireless transceiver.

48. The method of claim **41**, further comprising causing game-relevant information to be displayed on a display screen operatively associated with said portable wireless gaming device based on one or more wireless communications received by said second wireless transceiver.

49. The method of claim **41**, further comprising causing said portable wireless gaming device to illuminate based on one or more wireless communications received by said second wireless transceiver.

50. The method of claim **41**, further comprising causing said portable wireless gaming device to vibrate or emit sound based on one or more wireless communications received by said second wireless transceiver.

51. The method of claim **41**, further comprising automatically storing said one or more captured digital images in association with one or more image identifiers or timestamp information.

52. The method of claim **41**, further comprising automatically capturing one or more video images of said game participant while said game participant is playing said interactive game.

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